THE

JOURNAL OF GAS LIGHTING,

WATER SUPPLY, & SANITARY IMPROVEMENT.

VOL. XX. No. 493—23RD YEAR.] LONDON, AUGUST 29, 1871. [Subscription per Annum. { 15s. in Advance. 18s. Credit.] DOUBLE No. Price 1s.

RAMSAY'S NEWCASTLE CANNEL COAL. Analysis—10,000 cubic feet of gas per ton of coal; 26-candle gas; 13¼ cwt. coke per ton of coal.

RAMSAY'S PATENT CONDENSED COKE.

DO. GARESFIELD COKE.

RAMSAY'S FIRE-CLAY ARTICLES.

GAS-RETORTS, introduced 1838. FIRE-BRICK WORKS, established 1804. FIRE-CLAY SANITARY PIPES. CHIMNEY-TOPS, and all Goods made of Fire-Clay. The Fire-Clay is worked from Blaydon Main Colliery, is of excellent quality, and no expense spared in perfecting every article. The FIRE-BRICKS (marked "RAMSAY") are to be seen in all parts of the world, and the Works are the most extensive in the Kingdom.

Manufactories—Derwenthaugh, Swalwell, and Hebburn Quay, near Newcastle-on-Tyne; and London Wharves—Falcon Wharf, No. 80, Bankside; and Honduras Wharf, Cubit Town. Large stocks kept.

Address G. H. RAMSAY, NEWCASTLE-ON-TYNE.

GEORGE GLOVER & CO.,

Patentees of the Standard Gasometers for the Government, and of the

IMPROVED DRY GAS-METERS.

These Meters are warranted to measure correctly and not to vary. Their acknowledged superiority has brought them into general use more rapidly than any Meters hitherto manufactured.

To meet the increasing demand, G. GLOVER AND CO. have just entered on possession of extensive premises adjoining their present Works in Ranelagh Road, and they are now prepared to execute promptly, orders to any extent. They keep in stock all sizes of Meters up to 200 lights. In cases of haste, on the receipt of a telegram early on one day, their Meters can be delivered next day in any part of England, and in the large towns in Scotland.

Particulars and lists of prices forwarded on application to—

RANELAGH ROAD, PIMLICO, LONDON, S.W.;

236, GEORGE STREET, GLASGOW;

OR

15, MARKET STREET, MANCHESTER.

COWEN'S PATENT FIRE-CLAY RETORTS.

JOSEPH COWEN and CO.,

BLAYDON BURN, NEAR NEWCASTLE-ON-TYNE,

Were the only parties to whom a PRIZE MEDAL was awarded at the GREAT EXHIBITION of 1851, for "GAS-RETORTS and OTHER OBJECTS in FIRE-CLAY," and they have also been awarded in the INTERNATIONAL EXHIBITION of 1862, the PRIZE MEDAL for "GAS-RETORTS, FIRE-BRICKS, &c., for EXCELLENCE of QUALITY."

J. C. and Co. have been for many years the most extensive Manufacturers of Fire-Clay Retorts in the United Kingdom; and orders for Fire-Clay Retorts of all shapes and dimensions, Fire-Bricks, and every other article in Fire-Clay, are promptly executed at their Works as above.

COWEN'S GARESFIELD COALS.

Coal Office,

QUAY SIDE, NEWCASTLE-ON-TYNE.

FIRST PRIZE IN THE PARIS EXHIBITION.

JOHN RUSSELL and CO.,

THE OLD TUBE-WORKS,

CHURCH HILL, WEDNESBURY;

ALMA WORKS,

WALSALL, STAFFORDSHIRE;

and 69, UPPER THAMES STREET, LONDON,

Original Manufacturers of Wrought-Iron Gas-Tubes, and Holders of the present Patents; Inventors and First Makers of LAP-WELDED FLUES for Steam-Boilers.

J. R. and Co. make all kinds of Tubes and Fittings for Gas, Steam, and Water, and the largest orders may be executed in a few days.

Gun Metal, and all other kinds of Cocks, Stocks, Dies, and Taps, Galvanized Tubes, &c.

N.B.—All goods thoroughly tested before sent out, and warranted.

JOHN BENT & SON,

WET AND DRY GAS-METER

AND

STREET-LAMP

MANUFACTURERS,

BELL BARN ROAD, BIRMINGHAM.

ESTABLISHED 1830.

All materials found for the alteration of Public Lamps for lighting with the Rod. Regulators with Lava Burners.

BLAYDON BURN AND LOW BENWELL FIRE-CLAY RETORT AND FIRE-BRICK WORKS,

NEAR NEWCASTLE-ON-TYNE.

WILLIAM COCHRAN CARR begs most respectfully to thank the Metropolitan, Provincial, and Continental Gas Companies for their patronage for several years past, and to intimate that he has rebuilt and enlarged his extensive premises for the manufacture of CLAY RETORTS; and that he is now prepared to execute the largest orders with punctuality and despatch. Orders for FIRE-CLAY RETORTS, of all shapes and sizes, FIRE-BRICKS, and all other articles in Fire-Clay, executed on the shortest notice, and on the most reasonable terms.

London Agents: JAMES LAWRIE & CO., 63, OLD BROAD STREET, CITY, LONDON.

SCOTTISH CANNEL COAL.

J. & W. ROMANS, Consulting Gas Engineers and Coal Factors, of Edinburgh and London, CONTRACT for supplying any quantity of COAL and CANNEL.

They are also Contractors for leasing Gas-Works, for supplying, erecting, or repairing gas apparatus and fire-clay goods.

Messrs. ROMANS, being lessees of several Gas-Works, have their Cannels tested in the ordinary working process, thus securing for their customers a guarantee beyond mere laboratory experiments.

Analysis, prices, and other information will be forwarded on application to their Offices, 8, Forth Street, EDINBURGH: 1, Walbrook, Mansion House, LONDON, or to the "Crown Wharf," Thomas Street, Limehouse, LONDON, where stocks of house, steam, and gas coal are always on hand.

Coal, machinery, fire goods, &c., shipped to all parts of the world.

LESMAHAGO GAS COAL,

AUCHINHEATH COLLIERY,

LESMAHAGO N.B.

JAMES FERGUSON & CO.

LESSEES SINCE 1832.

LONDON AGENTS:

JAMES LAWRIE & CO.,

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CONTINENTAL AGENTS:

LA COUR & WATSON,

LEITH.

CROLL'S DRY GAS-METER,

PRIZE MEDALS.

LONDON, 1851;
NEW YORK, 1853;
PARIS, 1855.

(INVENTED & PATENTED IN 1844,)

COMBINING ALL THE LATEST IMPROVEMENTS,

MANUFACTURED ONLY BY

PRIZE MEDALS.

LONDON, 1862;
DUBLIN, 1865;
PARIS, 1867.

THE GAS-METER COMPANY, LIMITED,

238, KINGSLAND ROAD, LONDON, N.E.

MEDAL AWARDED, EXHIBITION, 1862, "FOR GOOD WORK."

THE IMPERIAL TUBE COMPANY, BIRMINGHAM,

MANUFACTURERS OF

WROUGHT-IRON TUBES & FITTINGS, BRASS & COPPER TUBES,

GALVANIZED & GLASS ENAMELLED TUBES & FITTINGS,

LAP-WELDED IRON & BRASS BOILER-TUBES, ETC., ETC.

Twyere Coils for Blast Furnaces, Boring Tubes, Core Bars, Gun-Metal and other Cocks, Boiler Mountings, &c.

HUGHES'S PATENT TAPS FOR HIGH PRESSURES.

WHITEHOUSE AND COMPANY, LIMITED,

GLOBE TUBE-WORKS, WEDNESBURY; & VICTORIA TUBE-WORKS, GREAT BRIDGE,

MANUFACTURERS OF

PATENT WELDED WROUGHT-IRON TUBES,

FOR GAS, STEAM, AND WATER;

STEAM-COCKS, AND ALL KINDS OF GAS-JOINTS.

LONDON OFFICE: 115, LEADENHALL STREET, E.C.

C. & W. WALKER'S

DOUBLE-FACED GAS-VALVES FOR LARGE MAINS.

These Gas-Valves for large bores are specially constructed of unusual strength and solidity. The Valve itself is a rigid wedge of cast iron, having two perfectly scraped surface facings, fitting between the two in the body, which are also surfaced. They are guaranteed absolutely tight under any chemical or other test for mains of the largest diameter, at a very moderate price.

Midland Iron-Works, Donnington, near Newport, Shropshire; 8, Finsbury Circus, London.

HENRY HOWARD & CO.,

COOMBS WOOD PATENT TUBE-WORKS.

OLD HILL, near DUDLEY,

MANUFACTURERS OF

HOWARD'S PATENT IMPROVED WROUGHT-IRON TUBES,

FOR GAS, STEAM, AND WATER;

Also ORDINARY WELDED WROUGHT-IRON TUBES and FITTINGS,

FOR GAS, STEAM, & WATER, EITHER BLACK, GALVANIZED, OR ENAMELLED.

CORE BARS FOR IRONFOUNDERS, STOCKS, TAPS, AND DIES, IRON COCKS, &c.

London Agent—W. G. DAVIS, 2, Brabant Court, Philpot Lane, E.C.

SILVER MEDAL, PARIS EXHIBITION, 1867.

LLOYD AND LLOYD,

ALBION TUBE-WORKS, BIRMINGHAM,

MANUFACTURERS OF

WROUGHT-IRON TUBES AND FITTINGS

For Gas, Steam, Water, &c.

SOLE LICENSEES AND MANUFACTURERS for the United Kingdom of

THE LAVENANT PATENT ENAMELLED TUBES AND FITTINGS.

LAP-WELDED IRON & HOMOGENEOUS METAL TUBES

For Locomotive, Marine, and Stationary Boilers.

Boiler-Tube Ferrules, Gun-Metal Gland Cocks, Water-Gauges, Whistles, &c.; Stocks, Taps, and Dies for Screwing, and Gas-Fitters Tools of all kinds.

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LONDON: No. 157, Upper Thames Street, E.C. LIVERPOOL: No. 63, Paradise Street. MANCHESTER: Barlow's Croft, Chapel Street, Salford. PARIS and LILLE.

WILLIAM INGHAM AND SONS,

WORTLEY FIRE-BRICK AND RETORT WORKS,

Near

Leeds.

W. INGHAM and SONS, having for many years been extensively engaged in the Manufacture of

RETORTS AND FIRE-BRICKS FROM THE CELEBRATED WORTLEY FIRE-CLAY,

beg to call especial attention to their RETORTS, which have for many seasons proved to be unsurpassed in quality by any in the Kingdom, their FREEDOM FROM CRACKS and the ADHESION OF CARBON rendering them worthy the attention of all parties interested in the making of Gas.

The Works are of such magnitude as to ensure the prompt execution of orders to any extent.

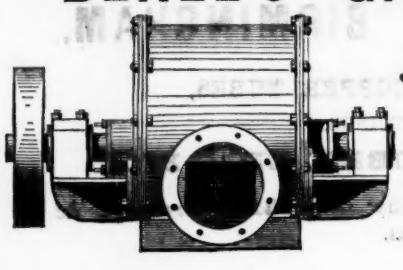
Estimates for Setting, or Bricklayers sent when required.

GAS OVENS IN SEGMENTS OF EQUAL QUALITY.

A large Stock of Fire-Bricks, Fire-Clay, Terra Cotta, and Drain-Pipes of all Sizes kept in London at Mr. ALFRED WILLIAMS, Wharf, 64, Bankside, Southwark, where all particulars of Prices, &c., may be obtained.

N.B.—*Export orders continue to have prompt attention.*

BEALE'S GAS-EXHAUSTER IMPROVED.



FROM 250 TO 250,000 CUBIC FEET PER HOUR.

Since Mr. BEALE'S retirement, the Oldest Makers are

J. BURTON, SONS, AND WALLER,

MAKERS OF ENGINES, MACHINERY, and IRONWORK for GAS-WORKS.

Efficient and durable TAR, LIQUOR, and SYPHON PUMPS.

GAS-VALVES in stock, 2 inches to 30 inches.

SELF-ACTING BYE-PASS VALVES, with Lid and Relieving Lever,

ROTATORY, TUMBLER, and CAPILLARY WATER DISTRIBUTORS for SCRUBBERS.

EXHAUSTERS from 3000 to 30,000 per hour in stock.

HOLLAND STREET, BLACKFRIARS, LONDON, S.E.,

Between Blackfriars' and Southwark Bridges.

THOMAS PIGGOTT & CO.,

(Established 1822,)

SPRING HILL, BIRMINGHAM,

MANUFACTURERS OF

TELESCOPIC & SINGLE GASHOLDERS,

CAST & WROUGHT IRON TANKS FOR DITTO;

PURIFIERS, CONDENSERS, SCRUBBERS, RETORTS, VALVES;

IMPROVED WROUGHT-IRON RETORT-LIDS, CROSS-BARS, & SCREWS;

AND GAS APPARATUS OF EVERY DESCRIPTION.

CAST AND WROUGHT IRON GIRDERS, BRIDGES, AND ROOFS,

STEAM-ENGINE BOILERS, & GENERAL WROUGHT-IRON WORK.

London Agents: PORTER and LANE, 172, FENCHURCH STREET, E.C.

D. BRUCE PEEBLES & CO.,

ENGINEERS, WET AND DRY GAS-METER MANUFACTURERS,

BRASSFOUNDERS, & GAS APPARATUS MANUFACTURERS,

FOUNTAINBRIDGE WORKS, EDINBURGH.

SOLE MANUFACTURERS OF

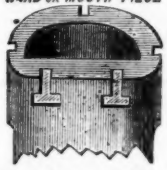
Peebles' Patent Wet and Dry Gas-Meters in Tin-Plate Cases, with Tongue and Groove Joints.

IMPROVED WET METERS IN CAST-IRON CASES.

STATION-METERS, GOVERNORS, EXPERIMENTING METERS, PHOTOMETERS, PRESSURE-GAUGES, &c.

KING BROTHERS,

STOURBRIDGE FIRE-BRICK AND RETORT WORKS.

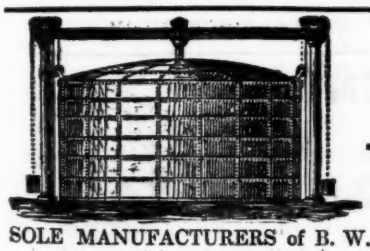


KING BROTHERS beg especially to call the attention of Gas Companies to the superiority of their Retorts, which are made from the celebrated STOURBRIDGE FIRE-CLAY. Mr. King has patented a Kiln for burning Retorts, by which Patent all Cold Air is excluded from the Kiln while burning, thus rendering them FREE FROM CRACKS AND CORRECT IN FORM. By great care in Manufacturing, combined with the advantages in burning, a VERY SMOOTH SURFACE is obtained, rendering them less liable to carbonize.

Retort Ovens, Fire-Bricks, Guards, Saddles, Rabbitted Burs, Flues, and Quarries, are all Manufactured of the same quality of Clay.

Every Retort and Brick is branded "King Brothers, Stourbridge."

Agent in Ireland—Mr. JAMES FURNESS, No. 3, FOWNES STREET, DUBLIN.



IMPROVED GAS APPARATUS,

FOR CITIES, TOWNS, VILLAGES, &c.,

INVENTED AND MANUFACTURED BY

W. C. HOLMES & CO.,

WHITESTONE IRON-WORKS, HUDDERSFIELD.

SOLE MANUFACTURERS of B. W. THURSTON'S IMPROVED SCRUBBER, CONDENSER, and WASHER, in use in many of the principal Gas-Works on the Continent.

PATENTEES of the IMPROVED COMBINED PURIFYING APPARATUS, so eminently adapted for Exportation.

ESTIMATES, PLANS, and SPECIFICATIONS PREPARED for BUILDINGS and APPARATUS.

Prospectus, Price Lists, &c., on application.

LONDON OFFICES—57, GRACECHURCH STREET, CITY

*** *Please address letters to Huddersfield.*

REFERENCES TO NEARLY 300 GAS-WORKS.

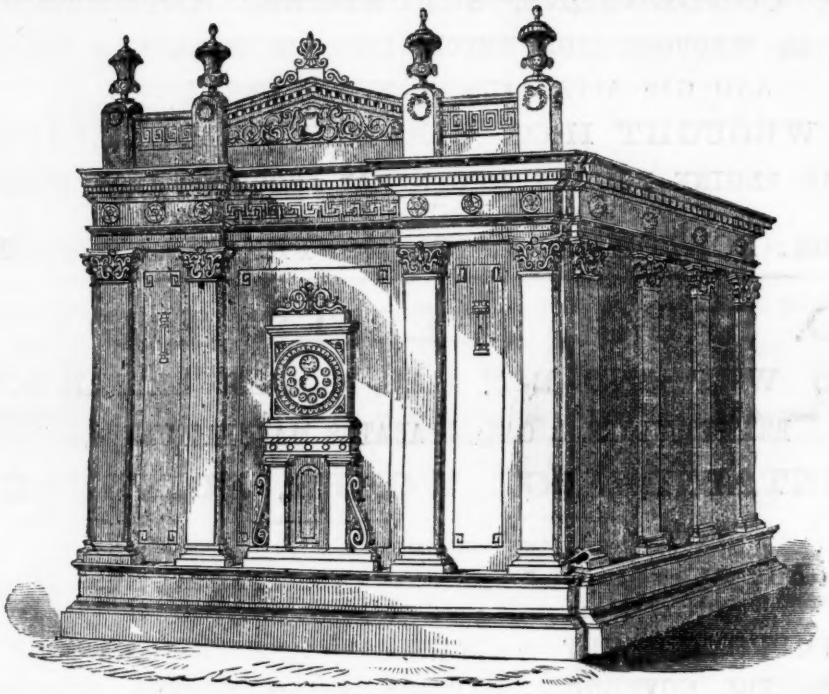
WILLIAM & BENJAMIN COWAN,

WET & DRY GAS-METER MANUFACTURERS, BRASSFOUNDERS, &c.

ESTABLISHED 1827.

Sole Manufacturers of ESSON'S PATENT COMPENSATING GAS-METER,
AND OF
COWAN'S PATENT SIDE-VALVE GAS-METER,

BUCCLEUCH STREET WORKS, EDINBURGH.



W. & B. COWAN'S SQUARE STATION-METER with PLANED JOINTS.

GOVERNORS, PRESSURE REGISTERS, TEST GASHOLDERS, GAUGES, &c.

W. & B. COWAN'S DRY GAS-METERS, in CAST-IRON CASES,

Possess a simplicity of construction and facility for repair greater than any yet produced, while the excellence of the material and workmanship, and accuracy of registration, cannot be surpassed. The superiority of their Dry Meters in Tin Cases is also well known, having stood the test of years.

PRICE LISTS ON APPLICATION.

E. J. & J. PEARSON,

DELPH & TINTAM ABBEY FIRE-CLAY & BRICK WORKS,

STOURBRIDGE,

PROPRIETORS OF

BEST GLASS-HOUSE POT & CRUCIBLE CLAY:

MANUFACTURERS OF

GLASS-HOUSE POTS, CRUCIBLES, GAS-RETORTS, & FIRE-BRICKS OF EVERY DESCRIPTION.

1862.

PATENT ANTIMONY PAINT.

CLASS II.

MADE ONLY BY

GEORGE HALLETT & CO.,

296, ROTHERHITHE, LONDON, S.E.

This Paint having been in general use over nine years (especially in some of the principal Gas-Works), and proved itself the best light-coloured Paint produced for resisting the influence of vitiated atmospheres, it is important that its qualities should be more widely known.

It is not discoloured like white lead in a sulphuretted atmosphere, nor washed off like white zinc; and its light colour reflecting heat, produces much less expansion of gas in holders painted with it than with dark colours, besides rendering them much more sightly. Its specific gravity is so much below white lead that the same weight will cover one-third more surface, while it is equal in body; and its price being about the same (30s. per cwt.), it is actually one-third cheaper. From experience, its manufacture is greatly improved, and it is quite suitable for all purposes in which white lead is employed.

Reference is kindly permitted by the Engineers of the City of London, Commercial, London, and Surrey Consumers Gas Companies, who pronounce it the best Paint known for their purposes.

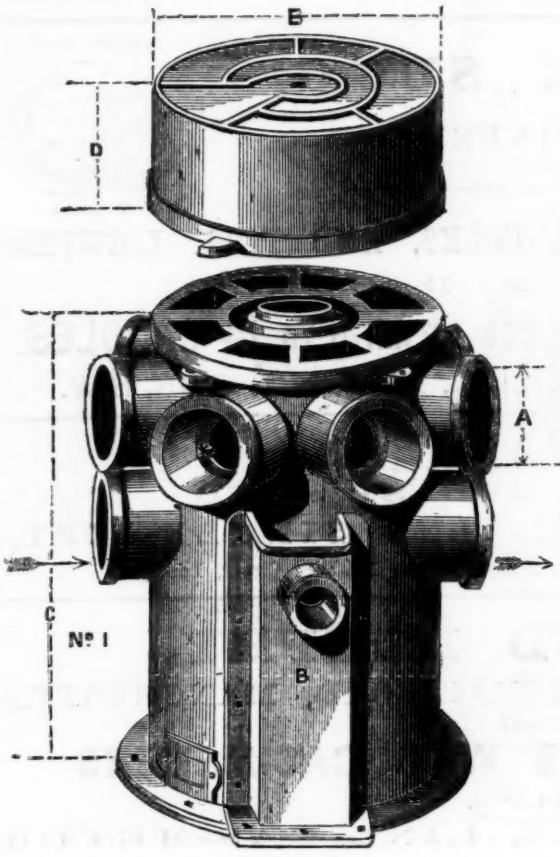
N.B.—Antimony Paint, COVERING SO MUCH MORE WORK, costs about 20s. per cwt., as compared with White Lead at 30s. per cwt.; a similar economy arises from its use in Steam and Gas Joints, for which purpose it is superior to White Lead.

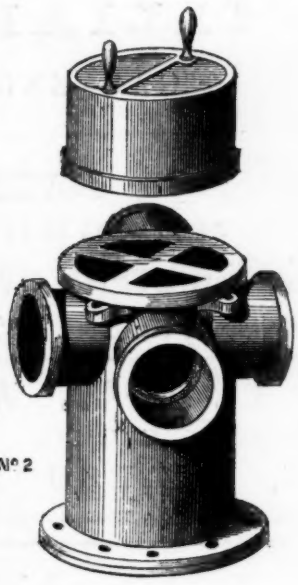
THE THORNCLIFFE IMPROVED CENTRE-VALVE,

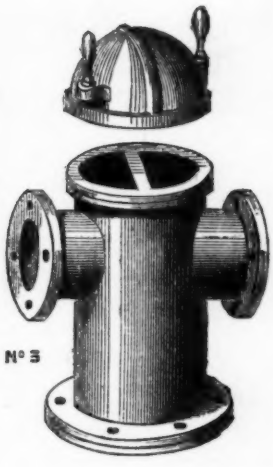
MANUFACTURED BY

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS, NEAR SHEFFIELD.







Sizes of the

THORNCLIFFE IMPROVED CENTRE-VALVE.

		Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.	Ins.
A	Bore of Pipe...	4	5	6	7	8	9	10	12
B	Diam. of Body.	16	20	23	26	28	31	34	40
C	Height of Tank.	33	35	38	43	46	48	51	56
D	Depth of Cover.	8	9	10	11	12	13	14	16
	Total height...	41	44	48	54	58	61	65	72

THORNCLIFFE IMPROVED BYE-PASS VALVE.

SIZES

From 3 ins. upwards.

THORNCLIFFE IMPROVED STOP-VALVE.

SIZES

From 3 ins. upwards.

In all cases the Covers are cast heavy enough to resist any required pressure.

The advantages derived from the adoption of these Valves are so manifest and cardinal that in the immediate character of the change—the simplicity of the machine—the facility affording for cleaning out connexions between Valve and Purifier—the perfect collection and delivery by suitable overflow of the ammonia, at a greatly diminished depth from ground-line over the old form of Valve—the advantage of connecting on the same level, and at any angle, or opposite to each other, the inlet and outlet pipes without dip or rise—the clear acquisition of space in the purifying-house, by being able to place the boxes nearer together, the new Valve being entirely under the floor—and lastly, though of the greatest importance, the passage of crude and unpurified gas during the change is minimized to the merest fraction, thus preventing the fouling by impure gas the delicate machinery and easily affected exposed movements of the station-meter, thereby preventing the introduction of the enemy (unpurified gas) into the gasholder. Also a dead abutment is offered to all back pressure, imparting thereby to the gauges, governors, and hydraulic seals, a steadiness of action never realized with the once famous, but now fast becoming obsolete, Hydraulic Centre-Valve.

These Valves may be made of any size to suit any position of boxes, to stand any amount of pressure, warranted and tested with gas before leaving the manufactory, prepared to work any number of boxes in rotation—say, two, three, four, five, six, or eight—and for all Valves above 12-inch ports a suitable rack-and-pinion movement is attached if preferred. These Valves (specially arranged) are applicable to inlet or outlet pipes of gasholder, to act as Bye-pass Valves to meters, governors, exhauster, condensers, scrubbers, washers, driers, and duplicate systems of hydraulic main; also to act as Stop-Valves on special mains about the works. Where it is important no impediment be offered to tar or ammoniacal liquor, the same having uninterrupted flow to the general tar-well on the works, and for which purpose the slowly changed, often disordered, and at all times obstructive Slide-Valve (challenging the best of them) is superseded by the exceedingly simple, instantaneously changed Dome-Top Valve, which also carries so marked an index, whether open or shut, at any distance from close observation, providing the Valve can be seen at all. See sketch in perspective, No. 3.

London Office—34, LONDON WALL, MOORGATE STREET, E.C.

JOHN HALL & CO.,

STOURBRIDGE,

MANUFACTURERS of FIRE-BRICKS, LUMPS, & TILES,

AND EVERY DESCRIPTION OF FIRE-CLAY GOODS.

N.B.—A Stock of 15 and 16 in. CIRCULAR RETORTS always on hand. Other kinds made to order on short Notice.

PARIS, 1867.

CLASSES 24 and 53.

WILLIAM SUGG,

GAS ENGINEER.

LONDON, 1862.

CLASSES 13 and 31.

PUBLIC LAMP GOVERNORS, LEVER COCKS, AND POLE LIGHTERS,

LAMP METERS AND BOXES.

LOWE'S JET PHOTOMETERS CAN NOW BE RATED TO 14 CANDLES.

VINCENT WORKS, VINCENT STREET, WESTMINSTER, S.W.

C. & W. WALKER

CONSTRUCT THE LARGEST SIZED

GASHOLDERS, TELESCOPE AND SINGLE-LIFT,

Midland Iron-Works, Donnington, near Newport, Shropshire; 8, Finsbury Circus, London.

FLETCHER AND MURPHY,

GARRATT STREET WORKS, OLDHAM ROAD, MANCHESTER;

Manufacturers of

IMPROVED CONSUMERS WET GAS-METERS

IN CAST-IRON CASES,

THE UNVARYING WATER-LINE GAS-METER,

AND

IMPROVED DRY GAS-METERS;

STATION-METERS OF ALL SIZES, with PLANED JOINTS;

GOVERNORS, PRESSURE AND EXHAUST REGISTERS, TEST HOLDERS,

And all kinds of Experimental Gas Apparatus.

MESSRS. NEWTON, CHAMBERS, & CO.,

THORNCLIFFE IRON-WORKS AND COLLIERIES,

NEAR SHEFFIELD.

CELEBRATED SILKSTONE GAS COALS.

Analyses by F. J. EVANS, Esq., Chartered Gas Company, Horseferry Road, Westminster:—

(COPY.)

Description.	Cubic Feet of Gas per Ton of Coals.	Illuminating Power in Candles.	Coke per Ton of Coal used. Cwt.	Ash in Coke per Cent.	Sulphur in Coa per Cent.
Best Silkstone . .	10,900	17·0	12·8	2·6	1·7
Norfolk Silkstone . .	11,000	15·94	12·5	4·4	1·64
Silkstone Brights . .	11,500	14·5	12·6	7·4	1·85
Silkstone Nuts . .	10,800	15·85	12·66	6·0	0·69

NOTE.—The illuminating power of the Gas was tested by the standard burner now used in London by the Gas Referees, under the City of London Gas Act, 1868.

Horseferry Road, Westminster, March, 1870. (Signed) F. J. EVANS.

OFFICES, 34. LONDON WALL, CITY, E.C.

TANGYE BROTHERS & HOLMAN,

10, LAURENCE POUNTNEY LANE, LONDON, E.C.;

And BIRMINGHAM (TANGYE BROS.), CORNWALL WORKS, SOHO.

SOLE MAKERS OF

MORTON'S PATENT SELF-SEALING RETORT-LIDS,

WITH HOLMAN'S PATENT ECCENTRIC FASTENINGS.

Over 1000 of the Patent Retort-Lids and fastenings already supplied to the great works of The Gas Company at Beckton.

Several hundreds in use at the works of the London Gas Company.

FIG. 1.

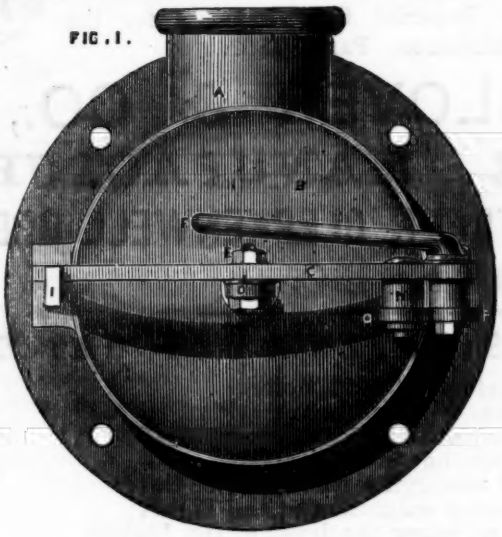
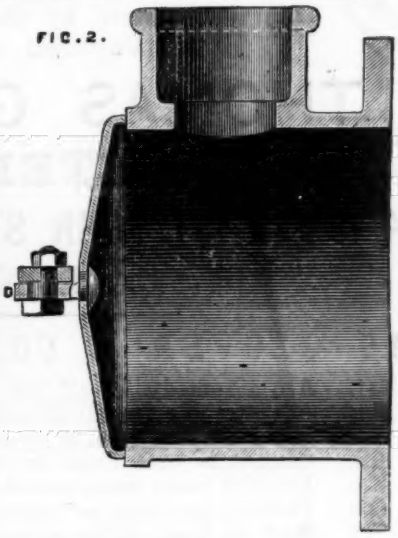


FIG. 2.



Adopted in the Gas-Works at

LIVERPOOL,
DUBLIN,
NOTTINGHAM,
ST. ALBANS,
BURSLEM,
BOURNEMOUTH,
WINDSOR,
BOSTON,
&c., &c.

THE "SPECIAL" STEAM-PUMP

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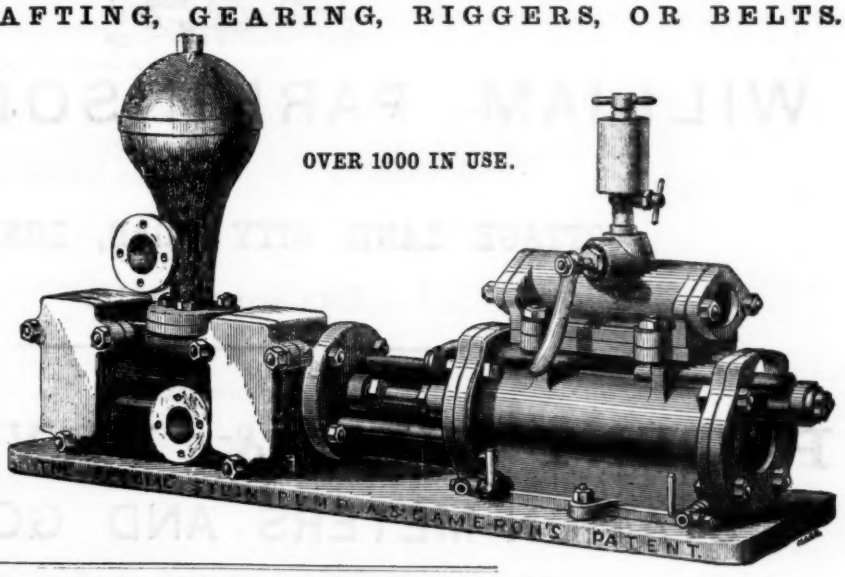

IMPORTANT TESTIMONIALS.

Manager's Office, Local Board Gas-Works, Middlesborough, March 19, 1868.

Dear Sirs,—In reply to your inquiry, I beg to say that the "Special" Steam-Pump, which you supplied to these works some months ago, has been at work ever since for pumping tar and ammonia water. I like it well, and am more than satisfied, for I am really pleased with its mode of doing double duty.

I am, very respectfully yours.

JOHN DUNNING, Manager.

Messrs. Tangye Brothers and Holman.

Richmond Gas Company, Manager's Office, Gas-Works, Richmond, June 17, 1868.

Dear Sirs,—I have the pleasure in stating that the three "Special" Steam-Pumps which we have in use—viz., one for water, one for pumping liquor through the scrubbers, and the other for filling tar barges, &c., are working well in every respect, and, I think, cannot be too highly recommended.

Yours truly,

JAMES ELDRIDGE, Manager.

Messrs. Tangye Brothers and Holman.

Sutton, Southcote, and Drypool Gas Company, Hull, May 1, 1871.

Gentlemen,—In reply to your note No. 410, April 29, I am very glad to inform you, that in a few hours after I got the pump started, and after I had written you, it did its work beautifully, and has continued to do so, throwing one day 4000 to 5000 gallons per hour, although you say 3250 gallons is its capacity. It is a splendid pump, the best I ever saw, and has just emptied a tank 82 feet diameter by 16 feet deep in 100 hours. I should have written to you some days ago had your note come earlier.—Yours truly,

F. W. OLDFIELD, Manager.

London, 1851. New York, 1853. Paris, 1855. London, 1862.

Dublin, 1865. Paris, 1867.

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TO CORRESPONDENTS.

No notice can be taken of anonymous communications. Whatever is intended for insertion, must be authenticated by the name and address of the writer; not necessarily for publication, but as a guarantee of good faith.

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The subscription is 15s. per annum if paid in advance during the month of January, or 18s. credit, in two sums of 9s. each, payable in July and January of each year.

All communications for the Editor should be addressed "No. 42, Parliament Street, London, S.W."

Remittances for subscriptions and orders for advertisements should be addressed to the publisher, William B. King, 11, Bolt Court, Fleet Street, London, E.C.

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THE JOURNAL OF GAS LIGHTING, WATER SUPPLY, & SANITARY IMPROVEMENT.

TUESDAY, AUGUST 29, 1871.

Notes upon Passing Events.

THE vestry of St. Bride's, Fleet Street, are about to perpetrate an act as disgraceful as anything done by rack-renting landlords in the worst days of Irish misrule. The parish owns a considerable plot of land in Spitalfields, which was let on a building lease to a Mr. Giles East, in October, 1778, which will expire at Michaelmas, 1871. This land has been sub-let, and is now covered with property of the very lowest description, including Union Court, much of it "unfit for the habitation of human beings." If this property were under the control of the Commissioners of Sewers of the City of London, or of a landlord who knew his duty to society, like the Marquis of Westminster, it would all be cleared away as soon as the lease expired; and it would be re-let on plans and conditions which would secure proper space, light, air, ventilation, drainage, and water supply for the humble tenants who, from the situation, must live in Spitalfields. Unfortunately, the leaders of the vestry, totally forgetting the Christian maxim that property has its duties as well as its rights, are determined to sacrifice not only all chance of dwelling-house reform but decency, in order to spend as little and get as much rent as possible. This is the nature of the report supported by Mr. Deputy Walter (who appears to have learned nothing from his association with the members of the Corporation who devote themselves to improving the poor dwellings of London). Mr. Hancock, in unsuccessfully opposing the adoption of the report, said:

> As regarded a great portion of the property, it was in such a state that no repairs could place it in a satisfactory condition. That was especially the case as regarded Union Court. The principle on which the committee seemed to have proceeded was that they should by repairs of the most unsatisfactory character bolster up the various properties for a time, so that they might best benefit the parish. If the property belonged to a private individual, that might be all very well; but the case here was that it belonged to the parish, and when they got the proceeds of it, they would be at a loss how to apply them. *The parish had already more charities connected with it than it could use, and what he would point out was that if they were going to improve this property they should do it in a manner which would render it available for the habitations of human beings.*

Such were the recommendations of the parish surveyor. But a large majority of the vestry sanctioned the perpetuation of the Spitalfield slums. We trust that daily papers of influence will take up this very appropriate subject for a cholera season, and that one of the illustrated papers will give us a picture of the courts and alleys the Philistines of St. Bride's propose to preserve. St. Bride's, Fleet Street, is the parish to which a certain class resort to qualify for its numerous and mischievous charities. A Lancashire man coarsely said of it, St. Bride's really "stinks of charities."

The preliminary report on the census of 1871 bears the signatures of the aged Major Graham, the sensational Dr. Farr, and Mr. Hammick, who enjoys an enviable obscurity; but from internal evidence, we should say it was written by some young relative of the doctor, preparing for the arduous duties of a penny-a-liner, or by one of the editors of that very dear pennyworth, the South Kensington Exhibition "Key." However, it contains, as it could scarcely fail to do, some amusing information, as well as texts for a "note" or two in our own peculiar way. First, we must say that if the enumerators satisfied the printed qualifications laid down by the Registrar-General, they were very cheaply hired at two guineas a head, and that amongst them must be some men whom any one with a large administrative work on hand would be glad to know and to hire. That they were not satisfied with their pay is not in the least astonishing. "Every person proposed for appointment as an enumerator must "be intelligent, trustworthy, and active. He must *write well*, and "have some knowledge of arithmetic. He must not be of such "weak health as to render him unable to undergo the requisite "exertion. He should not be younger than eighteen years of "age, nor older than sixty-five. He must be temperate, orderly, "and respectable, and likely to conduct himself with strict pro-"priety and civility in the discharge of his duties." If the census did nothing else than discover 35,000 persons with all these merits and accomplishments, it did a very wonderful work. The census was not made on the first day of the year, because, "in "England, the climate has to be considered." The day is short on the 1st of January, and the roads often in the very worst state for walking. At midnight on April 2, 1871, the population of England and Wales was 22,704,100 souls, or an increase of 2,637,884 over the numbers at the last census. The rate of increase, in 1861, was 12 per cent.; in 1871, in a like ten years, 13 per cent. The population of England and Wales in 1801, when the first census was taken, was 8,892,536. In the metropolis there is a steady tendency to diminish in the more ancient and crowded divisions, and to increase in the suburbs rendered accessible by cheap conveyances by road and rail. Within the memory of the present generation, the lowest price of any public carriage was one shilling. The ancient City of London annually diminishes the number of her resident inhabitants. Since 1861 the night population has dwindled from 112,068 to 74,732. At night the City streets are almost deserted, out of the line of main thoroughfares. In the day they are crowded by a population, estimated, from a day census made by the Corporation in 1866, at 170,133; and these numbers are probably increasing under the influence of extended trade, and the facilities for connecting the West and East, afforded by river, road, tramway, and railway. It may be noted that the importance claimed for the Corporation of London on the strength of this day census cuts both ways. If it shows that the City does the work of the metropolis, it also shows that the metropolis has a claim to a share in a responsible municipal government, to whose funds it so largely contributes, and that the management of an income so vast should not be left entirely to the representatives of obsolete wards, many of which are little better than the rotten boroughs which Parliament has twice extinguished. The enumerated population of the metropolis at the census of 1871 was over three millions and a quarter, but the population of the police district, which extends from 12 to 15 miles from Charing Cross, and includes purely rural tracts where sheep are white "and nightingales sing," to quote the poetry of the reports, contains a population of over three millions and eight hundred

thousand. Perhaps there is no more marvellous instance of the increase of the population of the London suburbs than may be seen from the roof of the Crystal Palace. Twenty years ago, rabbits and other wild animals abounded where now a complete town has been built, and this increase extends over the whole length of the railways to Croydon. We do not know what the reporters mean by saying that the natural place for the capital of a kingdom is its centre, as seen in Madrid in Spain. We thought it was generally admitted that the site of Madrid was the unfortunate mistake of an ignorant and despotic king. We take it that the Thames is the *raison d'être* of London, and the Seine (more important before roads were made than at present) of Paris. In the South-Eastern Division, which includes Kent, Surrey (except part in London), Sussex, Southampton, and Berks, the increase of population is 318,705, and the registered births exceed the deaths during ten years by 260,625; the total population being about two millions. Amongst the towns included in the increase between 1861 and 1871 are Kingston and Reigate—about 6000 each; Chatham about 8000; Canterbury has declined, Dover increased 3000, Margate 4000, Hastings 7000; Chichester has declined by about 300, while Brighton has reached over 90,000—being an increase of over 12,000, or about three times the population of the two cathedral cities of Canterbury and Chichester. Southampton has added 8000 to its population, Winchester has remained stationary, while Reading has increased by 7000, and Windsor, thanks to two railways, by 2000. The writer, who, in other districts, has indulged in some agricultural notes, has omitted to mention that the South Downs are the home of the best English mutton, and have sent out colonies of sheep to many counties. In the South Midland Division—viz., Middlesex (except London), Hertford, Buckingham, Oxford, Northampton, Huntingdon, Bedford, and Cambridge—Buckingham, Banbury, and Godmanchester have diminished in population. In Hertford, St. Albans, Aylesbury, and Huntingdon, there has been a small increase; while Oxford, Northampton, Peterborough, Bedford, and Cambridge, have added considerably to their population. The Eastern Division, including Essex, Suffolk, and Norfolk—purely agricultural counties—have only increased by seventy-five thousand souls, which represents the overflow from London into Essex—an overflow which is likely to be largely increased within the next ten years, under the influence of improved railway accommodation, which will attract City men to the beautiful undulating range of Essex hills beyond Romford. The Great Eastern, in connexion with the Metropolitan at Broad Street, will turn thousands of acres into villa building land. In the Western Division, including Wilts, Dorset, Devon, Cornwall, and Somerset—why Cornwall before Somerset we know not—the increase of population has been under fifty thousand in ten years. In Cornwall there has been an absolute decrease, due to the decline of the mines of that county. In Cornwall and Devon there is a great excess of females, as compared with Dorset. Although Devon and Cornwall are counties where small farms prevail, the population is the least dense of the ten—less dense than the purely agricultural Essex, Suffolk, and Norfolk. Few of the towns show any increase. Sea-bathing seems to have added 2000 to Weymouth, served by two railways, and the same improvement in communication has stimulated the ancient port of Barnstaple. The West Midland Division includes Gloucester, Hereford, Salop, Stafford, Worcester, and Warwick. It has increased by over 270,000 in the last census, Bristol figuring for over 28,000, and Stoke, the centre of the Staffordshire Pottery district, for rather more. In both we have the reviving and stimulating influence of railway communication. In 1840 Bristol was a decaying city. Although the rural towns and cities decline, or barely increase, the manufacturing centres and ports flourish. It is the same tale everywhere. Bristol, under old, exclusive ideas, up to 1845 treated all mercantile settlers as foreigners, and by excessive rates on shipping—both by sea and coasting—positively drove trade away. The first great Transatlantic steamer—the Great Western—was obliged to leave her native port after the original shareholders had incurred enormous losses. The Midland Railway, extended by a sort of *coup d'état* of King Hudson to Bristol, was the commencement of the sounder commercial policy which has added 50,000 to the population. The North-Western Division is composed of Cheshire and Lancashire. It is the smallest of the divisions, and the most populous. The increase, a little under half a million, is exactly the same as that of the metropolis, which is not extraordinary, as this division includes the twin capitals of Liverpool and Manchester. This increase has taken place notwithstanding the depression caused by the "cotton famine" during the American great rebellion, when the consumption of raw cotton fell off from 1000 million pounds to 309 million pounds, and 428 million pounds of very inferior quality during the two years 1862-3. Continental and American politicians had always prophesied that a failure of cotton would, in England, be followed by a bloody revolution. In the three years ending 1870 the consumption of cotton by manufacturers rose to its old standard. The reporter fails to notice that Birkenhead, which now contains 66,000 inhabitants, has been created, within the memory of middle-aged men of the present generation, from a village of two or three hundred inhabitants, sprinkled along the shore, by steamboat communication. A projected tunnel, if successful, will very soon double its population as a suburb and part of the port of Liverpool. We ourselves remember when Crewe, which now numbers about 10,000 inhabitants, was a village with one small roadside tavern, where hiring a trap to visit the then uninhabited Crewe Hall was an event. The village of Barrow-in-Furness, in Lancashire, under the stimulus of the working of hematite iron mines, has increased for an estimated population of 3300 to 18,000 in 1871. The North Division is composed of Yorkshire alone. Yorkshire excels in agricultural, in woollen, worsted, linen, iron, and steel manufacturers. The woollen manufacturers flourished while Lancashire and all the cotton districts were perishing for want of the American raw staple. Within the present generation, Sir Titus Salt gave Yorkshire a new manufacture in alpaca, wool, and its imitations. Bessemer stimulated the steel trade of Sheffield, and new processes of iron manufacture, have turned one of the wildest and most rural district of Yorkshire, of which Middlesborough is now the capital, into the most important iron district in England. In 1831, Middlesborough had a population of 383; in 1851, it had increased to nearly 8000; in 1861, to over 19,000; and in 1871, with a population of close on 40,000, it is a parliamentary borough, and returns as its member Mr. Bolckow, a naturalized German, who has done most to create this new and prosperous iron colony. The alterations in our commercial policy which were commenced by Huskisson, and culminated in the triumphs of Cobden and his unwilling pupil, Sir Robert Peel, have been especially favourable to the progress of the Yorkshire woollen and worsted manufacturers. The representatives of the manufacturers who petitioned Parliament that the exportation of British long wool should be prohibited, and that Spanish wool, then absolutely prohibited, should be admitted at a moderate duty, now import wool from Germany, the Cape, Australia, India, Egypt, and other countries of less importance, to the extent of more than 250 million pounds, the consumption having doubled in the ten years ending 1870; one result being that the working men who in the first quarter of this century wore second-hand clothes, now wear new clothes at much less cost. The tenth or northern division is composed of Durham, Northumberland, Cumberland, and Westmoreland, and with Yorkshire is certainly the cradle of one of the finest and most vigorous populations of the kingdom. There energy is the prevailing type. The increase of this division, in proportion to its population, is greater than that of Yorkshire; but this increase, amounting to 260,000, is confined to one district. The rural population, spread over picturesque, rainy, barren mountain and moor, is almost stationary. The old towns, such as Durham, Morpeth, Berwick, Cockermouth, and Whitehaven, show little increase. Whitehaven has decreased, but Stockton has doubled in ten years. The population of Sunderland, South Shields, Gateshead, Newcastle, and Tynemouth has largely increased. The four districts of Darlington, Stockton, Hartlepool, and Auckland have increased their population by 87,700. On the whole river Tyne the increase is nearly half a million. The eleventh and last division covers Wales, and includes Monmouthshire, which Henry VIII. turned into an English county, but which remains essentially Welsh. The increase of population over the whole district has been rather less than 10 per cent. The rural population do not increase; they emigrate to England for better wages. The increase is in the coal, iron, and copper smelting districts. We do not know what the reporter means by the goats of Wales. We suspect there are more goats in London and on the south coast than in all Wales, and the "well-known "Welsh ponies" are as of little importance as the Devonshire sheep and ponies on which the reporters also waste a line. What is the use of such a paragraph as this: "Welsh mutton is a well-"known product. The grain produced in Glamorganshire and some "other counties rewards the diligence of the farmer, but the "agriculture of the principality is not yet conspicuous for excel-"lence"? Penny-a-lining can scarcely go further. The simple fact being that the Welsh are ignorant and prejudiced, their ignorance and prejudice, encouraged by the Welsh clergy and Welsh squireens, are half a century behind the educated Scotch in everything connected with agriculture. With a rational education there is no reason why Wales, with a superior climate, should not equal Scotland in producing beef and mutton for the English market. Welsh sheep should be improved away by Cheviots and black-faced, which are both English colonists in the mountains of Scotland. On Exmoor the Cheviots and Scotch shepherds are profitably superseding the native breeds of sheep and shepherds. The chief increase is in South Wales, in the districts of which Cardiff, Merthyr Tydfil, and Swansea are the centres. There is an excess of nearly half a million women in the popula-

tion of England and Wales, whose proper mates are to be found in the United States and the Australian colonies. In leaving the subject for the present, we would observe that there is nothing in the figures of the census to support Mr. Disraeli's fantastic suggestion that the British race are deteriorating—quite the reverse. Our population, as a whole, is better fed, better clothed, and better lodged than at any previous date in our history. But it is more difficult to recruit fine tall soldiers, for a very simple reason. Where a man lives like an agricultural labourer of Cobbett's time, to take the pay and uniform of a soldier was to advance to an improved condition; but a well-grown labourer and spadesman can earn as a drainer his 3s. a day; as a navvy, 4s. 6d.; while a mechanic, fit for the Grenadier Guards, can earn his 6s. 8d. a day as a carpenter or mason, and, if sober and industrious, never be many days out of work. The barefooted Irishman, who made such a famous soldier, can earn his 18s. to a £1 a week for unskilled work in any of our iron shipbuilding or manufacturing districts. Hence the difficulties of the recruiting officers.

Mr. Josiah Parkes died a fortnight ago, in his 78th year, without, as far as we could ascertain, a single line of notice in any of our daily papers, or even in those possessors of universal knowledge, the *Saturday Review* and *Pall Mall Gazette;* yet Mr. Parkes, whose later years were passed in cynical seclusion, did more for the progress of agriculture all over the civilized world than any man of the present generation, not forgetting Baron Liebig, whom on one important question he signally discomfited. Mr. Parkes, who followed the occupation of a civil engineer before that profession—out of the mining districts—had advanced much beyond the rank of a land surveyor in the pre-railway times, first came before the public through his attempts, which were quite unsuccessful, to apply steam power to the cultivation of a peat bog of the same character as Chat Moss, which he had drained for Mr. Heathcoate, in Lancashire. His observations of the effect of the deep cuttings on the bog led him to make experiments, and by these experiments he *discovered the principles* of agricultural drainage, which were previously not only unknown but misconceived. The vulgar idea was, and is even with educated men who have never thought about the subject, that agricultural land suffers from rain falling on the surface. Mr. Parkes found that a deep drain began to run after wet weather, *not from the water above, but from the water rising from subterranean accumulations below*, and that by drawing the stagnant moisture from 3 or 4 feet of earth next the surface it was rendered more friable and porous, easier to work, and more easily penetrated by the rain, which carried down air, which is full of ammonia and manure, made it much warmer, and therefore more genial to the roots of the various crops. Without drains a retentive soil is saturated with stagnant water, which remains until evaporated by a warm season, and then leaves the soil hard-baked. Mr. Parkes came to the conclusion that 4 feet, which left a sufficient layer of dry warm surface earth, after allowing for the rise of the moisture by capillary attraction above the water level of the drain, should be the minimum depth. This is now the universally accepted opinion of the best agriculturists in England, France, and Germany. Smith, of Deanston, a very clever man, almost a genius, who never succeeded in anything, had previously devised a system of shallow drains, made of broken stones in the gridiron shape. But he missed the principle; he devoted his ingenious mind to devising expedients for getting the surface water into his drains. After a few years of contest the Deanston plan was entirely superseded by the Parkesian plan. In 1843, Mr. Parkes gave his evidence before a committee of the House of Lords on agricultural distress and its remedies. He was warmly supported by the Earl of Lonsdale, whose experience as a commissioner of highways had proved the soundness of the system; but nothing could be done without drain-cutting tools and pipes. A Birmingham manufacturer, on Mr. Parkes's suggestion, produced, in 1844, the first set of drain-cutting implements, which have since been brought to such extraordinary perfection. A cheap conduit was still a difficulty. Stones choked up in many soils, and where they had to be broken up and carted to the ground, their cost became enormous. At the Derby show of the Royal Agricultural Society in 1843, Mr. Parkes showed Lord Althorpe a cylindrical clay pipe, saying, "With this pipe, my lord, I will drain all England." This pipe had been made by wrapping a lump of clay round a mandrel, by John Reade—a self-taught mechanic—inventor of the stomach-pump, who was a gardener by trade, and used these hand-made pipes for draining his hot-beds. The council of the Royal Agricultural Society awarded John Reade a silver medal for his pipe, and offered a prize in the following year for a pipe-making machine. This prize was won by John Scraggs, at the Shrewsbury show in 1845, and was, we believe, the only prize offered by the society, in an existence of thirty years, that ever produced a useful original invention. Drain-pipes can now be manufactured quite as fast as kilns can bake them. In 1846, Sir Robert Peel, as an aid to the distressed and frightened agriculturist, passed an Act by which four millions sterling were advanced in loans charged on lands to be drained under Government inspection, on the Parkesian principle. The first loan was nearly entirely taken up by Scotch landowners. A second loan of four millions was granted in 1856; but these eight millions only formed a small proportion of the amount invested in the systematic deep drainage by the private enterprise of landowners and of companies formed for the purpose. By drainage, hundreds of thousands of acres of stiff clay soils, previously condemned to poor pasturage or uncertain crops of corn and beans, have been rendered friable, fit to grow roots, carry sheep, and fall into regular rotation. In Yorkshire, Mr. Parkes, for Lord Lonsdale, at an expense of from £10 to £20 an acre, reclaimed moor land not worth a rent of 1s. an acre, and raised its value to £2 an acre. Increased fertility of soil was not the only result. Systematic drainage led to general agricultural improvements; hedgerows and useless timber were cleared away, undulating ridges were levelled, roads made, and buildings erected to accommodate the production of meat as well as corn. It is also in evidence that the idea of pipe instead of brick sewers was first taken from the operations of Mr. Parkes in a Gloucestershire village to which he adapted his system. One of the curious incidents during the introduction of the Parkesian, or scientific system of deep drainage, was the virulent opposition of that able chemist, Baron Liebig, so malignantly prejudiced against everything English. The baron, about the time of the introduction of Mr. Parkes's principles and plans, introduced his patent universal manure, which proved so complete a failure, and seriously damaged the fortunes of the Liverpool chemists who undertook its manufacture. In order to push the sale of the patent manure, Dr. Liebig wrote a letter in its praise, and at the same time solemnly warned English farmers that deep drainage would reduce their lands to permanent sterility, by driving into the drains the principal elements of fertility. This ridiculous theory he has since, we think with a very bad grace, retracted. Mr. Parkes, like other men of original genius, had his foibles. He had not the art of managing men, and consequently a good deal of his early work on sound principles was very badly executed, and brought his system into disrepute. He was intolerant of advice and jealous of opposition, and consequently never adopted the improvements introduced by Mr. Bailey Denton and others, who took advantage of the natural porosity of any tract of soil to diminish the cost of the series of uniform gridiron drains, to which Mr. Parkes adhered to the last. He would never admit that any improvement on his original plan was possible. Still, it must be admitted, it was a great triumph to introduce an entirely new system, to be executed with entirely new tools and machines against the stubborn prejudices of the farmers, within the short space of thirteen years. Mr. Parkes, for his services, was elected an honorary member of the Royal Agricultural Society; he was also a member of the Institution of Civil Engineers, but although he made immense collections of notes on experiments, he never contributed to its Transactions. At one time he had upwards of 1000 men in his employment in drainage contracts, but he lived alone and apart—the only conversation he understood was a monologue. He was the brother of the late Mr. Joseph Parkes, a famous attorney politician in the days of the first Reform Bill, and the uncle of Miss Bessie Rayner Parkes, who has some reputation as a poetess, author, and advocate of the Rights of Women. Certainly, a portrait of Josiah Parkes, if extant, ought to adorn the walls of the National Portrait Gallery and the Institution of Civil Engineers. We take the substance of this memoir from an article in the "Quarterly Review" of April, 1858.

A very short Act has extinguished the Poor-Law Board and established "The Local Government Board," in which is to be vested all the powers and duties of the Poor-Law Board and of the Privy Council, including, according to the schedules, "The "Registration of Births, Deaths, and Marriages," "Public Health," "Drainage and Sanitary Matters," "Baths and Wash-houses," "Public Improvements," "Town Improvements," "Artisans and "Labourers Dwellings," "Local Taxation," "Prevention of Dis-"ease," and "Vaccination." The Local Government Board will consist of a president, to hold office during the pleasure of Her Majesty, and as *ex officio* member; the Lord President of the Privy Council, all the principal Secretaries of State, the Lord Privy Seal, and the Chancellor of the Exchequer. Mr. Stansfeld was appointed the first president on the 19th of August, 1871. The theoretical advantage of this consolidation is undeniable. Local authorities will no longer be driven from pillar to post for information and instruction. But the working will depend on the ability, intelligence, candour, and teachableness of the subordinate, not less than the principal officials.

The advice of Dr. Johnson, "to clear your mind of cant," is sure to be disregarded by the advertising Barnums of joint-stock advertising schemes. The promoters of the Alexandra Park Ton-

tine are really working the art, science, and educational dodge very hard. If the scheme succeeds, a very nice place of in-door and out-door amusement will be opened to those who can afford eighteenpence or a shilling, or whatever be the current price of the non-transferable admissions; but as the Crystal Palace, which started with equally grand pretensions, is open to Foresters and other *fêtes* at a very low rate, as South Kensington Museum, the British Museum, the National Gallery, Hampton Court, and all the parks, are open free, while admission may be obtained to all the science of the Zoological Gardens for sixpence, we do not quite appreciate the philanthropic enthusiasm of the duly retained advocates of a scheme which is to put £850,000 into the hands of the shareholders, mortgagees, creditors, and promoters of the Alexandra Park Company. Mr. Blanchard Jerrold appears to hold a brief from the tontine speculators, for he takes advantage of the letter of a travelling correspondent of the *Echo*, describing "the simple and refined amusements" of the Danes, to announce that "at length we have some hope—a little amendment—in "Alexandra Palace and Park," &c. What stuff! The Cockneys who "regret that Englishmen have no such amusements as con-"tinental nations," would prefer seeing our youth riding a round-about cock-horse, playing dominoes or billiards, instead of cricket and football, or rowing on the river. We never met a foreigner of any vigour who did not wish to see our rude and healthy games transplanted to continental schools and villages. Englishmen drink too much, there is no doubt; but it is not in Scandinavia that we must seek patterns of sobriety, and at Alexandra Park beer and brandy will be the most reliable sources of revenue.

THE METROPOLIS WATER ACT, 1871.

The Metropolis Water Bill (No. 2) was carried through its final stages in both Houses with marvellous rapidity, and has now become law. The proceedings before the select committee of the House of Lords on the last day were, perhaps, the most interesting of all in connexion with the Bill. They brought out the Metropolitan Board of Works in not altogether a new character, but in what we may call a character in a fuller state of development. The Board presumed not only to challenge the unanimous vote of the House of Commons, but to beard the Government, and we might almost say to bully the House of Lords. The fact is, the Board cannot gracefully accept a defeat, and, therefore, courted a snubbing when sensible people would have been satisfied with a failure. They are too blind or too conceited to recognize the fact, patent to every one outside, that the Board is doomed; that a year or two at the most will see the metropolis under the government of a very differently constituted body—a body which may, and must, be entrusted with the *whole* municipal business of the metropolis. The Board was called into existence for a specific purpose, which is now nearly accomplished; and, if well advised, they would prepare to expire with dignity. Such, however, is evidently not their intention; they mean to fight and squabble to the last. But by that they will not prolong their existence one day; and when they go they will depart with few benedictions.

The history of the recent water legislation is a curious one, and not creditable to all concerned. Bill No. 1 was conceived in a spirit of gross antagonism to the metropolitan water companies, and necessarily excited their strongest opposition. It bore the clearest evidence of rashness and ignorance on the part of the immediate promoters; and although it naturally received the earnest support of the Metropolitan Board, it was withdrawn as soon as the iniquitousness of some of its provisions was pointed out. The Act just passed is the result of earnest conferences between the companies, anxious on their part to do the best they can for the public (provided they receive adequate guarantees), and the Government, who are no less anxious to benefit the public, but not at the expense of great injustice to the companies. We cannot say that we regard this as anything more than a temporary measure; but, if cautiously acted upon, it is calculated to effect much good. A constant supply may or may not, in the end, prove a great blessing to the population, but it is certain that a rapid change from the one system to the other in the metropolis would be anything but a blessing. If, indeed, the companies had wished to consolidate their power and influence, they could not have done better than consent to give constant supply at once, twenty-four hours experience of which would probably have made all London pray for a return to the old system. This Act, however, which provides for a gradual change, and insists, in the interest of the public themselves, on time being given to make necessary alterations in the fittings, will cautiously prepare for the day when the whole metropolis may safely receive a constant supply at a sufficient pressure to reach the tops of the highest houses. And so made, the change will be effected at the least cost, both to companies and consumers. Much, however, depends upon one thing which cannot be safely calculated upon—the discretion of the Metropolitan Board. They would probably prefer to leave the Act as much a dead letter as the Act of 1852; but the companies may now, and no doubt will, take the initiative; and we shall be curious to see the result of the first notice sent to the Metropolitan Board of a proposal to provide a constant supply in any district. If the New River Company were malicious, they would at once propose to give such a supply to the district of St. George's, Hanover Square, and so elicit the opinion of not the least intelligent consumers in the metropolis. But we shall be disappointed if the companies do not honestly fulfil the obligations imposed on them by the Act, having due regard to interests which are as much those of the public as their own. It is no more the interest of the general public to have water wasted, than it is that of an individual consumer to have his house injured in consequence of being provided with imperfect fittings.

The general provisions of the Act may be summarized very shortly. The preamble states that it is expedient to make further provision for securing a constant supply of water in the metropolis, and adjacent districts. Disregarding the adjacent districts, the constant supply may be obtained in London proper in one of three ways. Either a company may propose to furnish such supply in any district, or, if in the City, the Corporation may require it, or outside, the Metropolitan Board of Works; or, lastly, the Board of Trade may, under certain conditions, insist on a constant supply in a district. In either case, however, the companies have the power of making regulations, which, if not complied with in four-fifths of the premises in a district, absolve them for the time from the obligation of giving such supply. It appears to rest either with the company or the metropolitan authority to enforce compliance with the regulations, and if neither elect to do so, the Act may remain a dead letter. In their present mood the Metropolitan Board do not seem at all willing to undertake the duty; but a little reflection may, perhaps, convince them of the advisability of making the best of what they now consider a bad bargain. It may be a defect in the Act that the duty is not made compulsory on one party or the other; but if the Metropolitan Board are sincere in their wish to obtain a constant supply of water, irrespective of any ulterior objects they may have desired, the manner in which they can procure it is perfectly clear.

We mention only the broad purpose of the Act, the details are of no particular importance. We have said that, if discreetly acted on, this measure is capable of conferring great benefits on the metropolis, and we shall watch with much interest the proceedings which may be taken under the Act.

Circular to Gas Companies.

Mr. Leeman's Bill to authorize local authorities to pay out of their public funds the expenses of promoting or opposing Bills in Parliament was finally withdrawn on the 14th inst., after having been kept on the notice-paper of business before the House of Commons for more than two months without the remotest chance of its becoming a law in the session now past. To be forewarned is to be forearmed. Mr. Leeman has given notice of his intention to introduce a similar Bill next session; it is, therefore, incumbent on all those whose interests are so seriously threatened by the measure to continue and extend their efforts to enlighten the public as to the probable consequences the Bill would have if passed into a law. The small notice the bill attracted from the general press of the country shows how little the effects of its provisions were understood, and steps should be taken to exhibit the matter to ratepayers in its true light. It is, as we have said, purely a ratepayers question. The Bill, if passed, will open the way to a most reckless and useless squandering of public money. We know no way in which so much money can be expended to so little useful purpose as in a parliamentary contest.

The money article of the *Times*, a few days ago, contained a paragraph respecting American railway confiscation which may be cited in condemnation of the system too frequently practised in this country, when local authorities attempt to deal with gas and water undertakings. The *Times* says:

> A question has arisen which may prove of considerable importance to investors in American railway securities. The Legislature of Illinois have passed a law, which was to go into operation on the 1st ult., to control the freight and passenger charges, and fix the tariff at a point that will seriously affect the profits of the companies. Looking at the desire likely to be felt by legislators and their clients to have the power of travelling and sending forward their produce on the lowest possible terms, this new system of interference must be regarded as a dangerous precedent. At the time when charters are granted, it is quite fair for a State to impose any stipulations it may think fit; but if, after their capital has been all expended, the shareholders are to find their profits likely to be regulated according to the pleasure of their customers, there will certainly be no persons willing to embark in such one-sided ventures.

This is an argument we have frequently urged—the discouragement thrown on private enterprise by governmental interference,

whether exercised by the State or by local authorities. Gas companies have to submit to too much of this. By a general Act they are limited to a maximum profit; by special Acts they are limited to maximum prices. So far no one complains. The conditions of the enterprise are well understood, and people are found not unwilling to risk their capital in undertakings which promise in the end to give them what we may call their guaranteed profits. But let us suppose Mr. Leeman's Bill passed into a law. As soon as a company promises to be successful, it excites the cupidity of a local authority; and now having the power to expend public moneys for the purpose, they, under the pretence that the proceeding is to the public advantage, promote a Bill to make a compulsory purchase of the undertaking at a cheap rate, before that stage of success is reached which the investors had a legitimate right to calculate upon. Or if we suppose the stage of success reached, and the company, having expended all their capital, apply to Parliament to raise further money for necessary extensions, under the same pretence the local authority steps in to oppose the Bill with a view to reduce the profits of the undertaking, and in the end to complete a cheap purchase. All this time possibly the undertaking has been the largest contributor to the rates in the district, and so, like the eagle, has feathered the arrow which struck it. There is a gross injustice in this which we are certain needs only to be pointed out to ensure the eventual defeat of a measure which threatens to be as detrimental to public as to private interests. In our remarks we have alluded only to gas and water undertakings; but there are others, such as private markets, docks, &c., whose interests are as seriously threatened as those we have specially mentioned.

The efficiency of the Gas-Works Clauses Act, 1847, in producing reductions in the price of gas, has been exemplified in the metropolis by the reduction announced by the Imperial Gas Company of 1d. per 1000 feet from July last, and by the Independent Gas Company of 2d. from September next; and in the provinces by the announcement made by the British Gas Company that they have reduced the price in Hull to 2s. 10d. per 1000 feet, with discounts as heretofore.

The report of the Metropolitan Board of Works for 1870-71, just issued, contains some interesting information as to the communications between Mr. Shaw Lefevre and the Board, relative to the gas legislation threatened in the past session. Early last November Mr. Lefevre sent for the Board, and informed a deputation that representations had been made to him (it is not said by whom) as to the desirability of introducing a Bill in the coming session to extend the provisions of the City of London Gas Act to the whole metropolis; and he invited the Board to initiate a Bill for the purpose. The deputation replied that while the Board would undoubtedly help forward such a measure as much as they could, they thought the Bill would have a better chance of success if introduced by the Government; and they supported their opinion by a reference to the decision of Mr. Cardwell's committee. Mr. Shaw Lefevre admitted a difficulty, but stated that the Board of Trade (*i.e.*, Mr. Lefevre himself) was of opinion that the question of gas supply was one that should be dealt with rather by the local authority than by the Government, and he, in effect, recommended the Metropolitan Board to take the initiative by issuing the requisite parliamentary notices. In the end, both Mr. Shaw Lefevre and the Metropolitan Board issued notices; but, as our readers know, nothing came of them. The Metropolitan Board think, however, that they have prepared the way for legislation next session.

The report also contains some paragraphs relating to the testing of gas. It is admitted that the quality of the supply has been fully equal to the requirements of the Acts of Parliament. The Board, however, complained of the quantity of sulphur in the Chartered Gas, and appealed to the referees to fix a maximum. The referees replied that the subject was under their consideration, and they had reason to expect that a more effective process of sulphur purification would be attained. In the meantime, the referees stated that they would require (how, has not yet been published) the gas manufactured at Beckton to be as free from sulphur as that made at Bow Common. The result has been that the amount of sulphur at Bow Common has gone up to the quantity in Beckton gas.

The Board then congratulate themselves on the success which has attended their efforts to have ammonia removed from gas.

In the past year we see that the officers of the Board have tested 66,416 meters, the fees for which amount to £2251 16s. By the amounts appended we find that the expenses of gas-testing and gas-meter testing amount to £2302 4s. 7d., so that the gas-testing at present costs the Board very little. Next year they will probably have four more testing-stations, but still the cost to them will be as nothing compared with that inflicted on the gas companies.

There is a sentence in the section of the report relating to tramways which we feel bound to quote. The Board had a strong itching to make tramways themselves, but, "In the first place, "they felt that there would certainly be a strong objection on the "part of many to the Board expending public money on a work "of this kind, partaking, as it would to some extent, of the cha- "racter of a commercial enterprise." Perhaps a similar consideration will withhold them from attempting to lay their hands on gas undertakings.

We publish to-day a process for determining the amount of sulphur in coal and coke, by Mr. F. C. Calvert, F.R.S., which we can recommend to our readers. A more common process than that mentioned by Mr. Calvert has been to ignite the coal or coke with chlorate or nitrate of potash, in the presence of a considerable quantity of chloride of sodium; and a common source of error is the presence of sulphate in the chloride of sodium. The preliminary washing suggested by Mr. Calvert may well be employed in combination with the process we mention, which we consider more satisfactory than oxidation by *aqua regia*.

We publish to-day the report of the gas referees on the ammonia impurity in gas, which shows that the referees have come to the conclusion that the whole of the ammonia can be easily and profitably removed from gas.

We are enabled in this number to publish a short report of the proceedings at the meeting of the North British Association of Gas Managers, recently held at Edinburgh. They call for small comment as yet. The address of the president dealt with commonplace matters, some of which, however, are deserving of more consideration than they have yet received. If we had had a full report of Mr. M'Crae's paper on the transfer of gas-works from private companies to Corporations, it might have called for some remark; but, as it is, we can only express a perfect concurrence with an opinion expressed by Mr. Whimster in the discussion which ensued—viz., that an original company which had broken ground in a district, but which had had its profits reduced by litigation and competition, is entitled to as high, if not a higher consideration in a contemplated purchase than a competing company which had been financially more successful.

An account of what is called a "vacuum process," the invention of Mr. M'Ilhenny, the engineer of the Washington Gas Company, comes to us from America. The invention is a remarkably simple and effective one for relieving dip-pipes from pressure in the hydraulic main while they are in action, and effectually sealing them while the retorts are being discharged and charged. For this purpose the hydraulic main is divided into compartments by bridges, each compartment receiving the pipes from one bench of retorts. To each compartment is supplied—first, a tar-pipe below the level of the seal; and, secondly, a water-pipe above the level of the dip. When the retorts are set in action, the cock of the first pipe is opened, and the tar and water are removed to a point that will leave the mouths of the dip-pipes exposed and unsealed. When the bench is drawn, the cock of the second pipe is opened, and water flows into the hydraulic main, and the dip-pipes are re-sealed. The advantages of this simple and effective process will be apparent to every one. The adoption of it will involve but little expense; the ordinary skill of a stoker will suffice to work it; and all the disadvantages arising from leaving gas in retorts under heat and pressure will be completely avoided. One point, however, must be carefully attended to—the tar-pipes must be sufficiently large to prevent them from being choked.

The proposal submitted to the National Assembly of France to impose a tax on gas has naturally excited great consternation amongst French gas companies, not less from its exorbitant amount—5 centimes per cubic mètre, equal to 1s. 1d. per 1000 feet—than from the mode in which it was proposed to be levied. Gas companies in France are, for the most part, under very different conditions to those obtaining in England. They have, in general, concessions for limited periods from municipalities, after the expiration of which the whole property of the company becomes vested in the municipality without fee or purchase; they have, therefore, to make such profits as will not only pay interest for the time, but enable them to recoup their expenditure at the expiration of the concession. Besides this, they are taxed and rated in a variety of ways happily unknown to English undertakings; and it may be safely said that, without any new imposition, the manufacture of gas is more heavily taxed than any other industry in France. The companies, it must be remembered, too, are bound to supply gas at a fixed price, and thus the proposal to levy the rate on the gas delivered for consumption saddles the tax on the companies. They cannot add it *pro ratâ* to every consumer's bill, because the exactions of the State and the municipalities seldom or never permit the supply of gas to private consumers at less than the maximum rate. Both the State and the municipality require gas to be supplied for public purposes at little more than prime cost; consequently, all the profit has to be made out of the private consumer, who thus indirectly pays for the public lighting. Without going into

details, we may say that, in one way and another, gas in Paris at the present time pays to the city and the State an *ad valorem* duty of 36 per cent. The imposition of the new tax would raise it 54 per cent.—a tax which no company in the position of the Paris Gas Company could possibly support. To smaller undertakings the tax would be simply and immediately ruinous. We read of one small company in France in which the tax would not only swallow up all the profits, but necessitate a call of 5000 francs per annum from the shareholders.

The history of the proposal is curious, and deserves a moment's attention. Scared by the alleged doings of the *petroleuses*, the Assembly, in their fright, put a heavy duty on petroleum, with the view of making incendiarism a dear luxury. In a calmer moment it occurred to them that to tax one source of light and not another was an injustice, more especially when the one was employed by the exclusively poor, and the other by a richer class. But they took no account of the *incidence* of the tax, nor indeed of their relative proportions; for while the tax on petroleum falls inevitably on the consumer, the gas-tax falls as certainly on the unfortunate possessor of *actions*. Moreover, there is no proportion in the taxation. The proposed tax, as we have mentioned, will raise the amount paid on gas in Paris to an *ad valorem* tax of 54 per cent.; while the duties already fixed on other sources of light, such as colza oil, wax and candles, is only 20 per cent. It is with much satisfaction we learn, on good information, that the proposal will not further occupy the attention of the Assembly this year. Time will give opportunity for calmer reflection.

Parliamentary Intelligence.

HOUSE OF LORDS.

MONDAY, AUG. 14, 1871.

The Royal Assent was given to the following Bills:—ALLIANCE AND DUBLIN CONSUMERS GAS, WATFORD GAS, BRIDGWATER WATER, and NEWRY BOROUGH IMPROVEMENT AND WATER SUPPLY.

Petitions were presented, praying that no alteration be made in the METROPOLIS WATER Bill, from the New River Company, and Kent Water-Works Company.

TUESDAY, AUG. 15.

Petitions were presented, praying that no alteration be made in the METROPOLIS WATER Bill, from the East London Water-Works Company, Lambeth Water-Works Company, and the West Middlesex Water-Works Company.

A petition was presented, praying that no alteration be made in the METROPOLIS WATER Bill, from the Grand Junction Water-Works Company.

METROPOLIS WATER BILL.

In moving the second reading of this bill,

The EARL of MORLEY said: My lords, I have to offer your lorships a very brief explanation of this measure. In the year 1852 an Act was passed regulating the water companies of the metropolis, and requiring them by the 8th section to provide a constant supply in their respective districts. There was, however, another provision requiring that there should be a written application proceeding from not less than four-fifths of the ratepayers of the district. That stipulation has rendered the former provision ineffectual, and the object of the present bill is to remedy the defect. It will compel the water companies to provide a constant supply to the houses within their respective districts; but at the same time it will oblige the owners and occupiers to provide means by which the water thus supplied may be prevented from being wasted. The application is to be made to the companies by what is called in the bill "the metropolitan authority"—the said authority being the corporation for the City, and the Metropolitan Board of Works for the rest of the metropolis; but if the company can prove that at least one-fourth of the houses in their district are not supplied with appliances to receive the water, it will not be compulsory on them to provide a constant supply. At the same time there will be an appeal to the Board of Trade. These are the main provisions of the bill. It has been accepted by the water companies, and the only objection to it comes from the Board of Works. I trust, however, that this bill will be allowed to pass this session, for there is reason to fear that a visitation of cholera may be at hand; and it is admitted that there is no more certain mode of spreading both that dreadful plague and other diseases than a supply of impure water, or a lack of pure water in sufficient quantity. I trust, therefore, that your lordships will read the bill a second time, that the opposition to it may be withdrawn, and that it may become law this session.

Lord REDESDALE: My lords, I am afraid that the opposition of the Board of Works is not very creditable to them, and I trust that some arrangement may be come to by which any reasonable objections that they may entertain upon any point may be removed.

The bill was then read a second time.

THURSDAY, AUG. 17.

The METROPOLIS WATER Bill was referred to a Select Committee, consisting of Lord Skelmersdale (chairman), Viscount Hawarden, Lord Suffield, Lord Denman, and Lord Hatherton, who will sit on Friday, Aug. 18, at eleven o'clock.

WATER SUPPLY.

The EARL of SHAFTESBURY, in rising to ask whether Her Majesty's Government intended to bring in a measure next session for improving the water supply, said: My lords, I trust I shall have from my noble friend a satisfactory answer. Your lordships are all aware of the great power and influence of the water companies, but that is an additional reason why the Government should come forward with some good measure to rescue us from the almost irresponsible power which the companies possess. Your lordships will recollect that a few years ago, when the late Lord Derby was in power, a commission was appointed to inquire into the sources of our water supply and its due administration. That commission made a most admirable and exhaustive report, but as yet nothing has been done to carry its recommendations into effect. It is the more necessary that something should be done at once, not only because there is need of a more ample supply, but because there are sources of corruption and mischief in the water itself which require to be corrected. I believe that at the present moment there is scarcely a pint of water to be had in London that can strictly speaking be said to be wholesome; and there is a great deal that is positively unsafe. That which is given by the water companies is by no means what it ought to be, and as to the wells, I believe that there is scarcely one from which water can be drawn and drunk without peril. The dangerous condition of the London well water has been discovered by recent observation; and now some of the most favourite pumps in the metropolis, such as that in Broad Street, and that in the Temple Gardens, which used to be so much resorted to for the beauty, the excellence, the clearness, and the coolness of their waters, have been obliged to be shut up, because their water was found to contain deleterious matter. I believe it is very well known that more mischief to the human constitution arises from bad water than from bad food, bad clothing, and bad housing. It is, therefore, most important that, with our population increasing as it is, this important ingredient in the health and happiness of the people should be cared for. There is scarcely a great town in the whole of this country which is not better supplied than the metropolis. Glasgow, Greenock, Manchester, Sheffield, and other places, are all supplied with ample reservoirs, into which it is impossible for any deleterious particle to find admission. I trust I shall hear from my noble friend that it is the intention of the Government, at the earliest possible moment, to deal with this question of the water supply. We are at this moment living in a state of panic. The cholera is believed to be at our door, and the water supply of four millions of persons living in London and its suburbs is, in all cases, of a very doubtful, and in some cases even of a dangerous, character.

Viscount HALIFAX was understood to say: My lords, I entirely agree with the noble lord that nothing can exceed the importance of providing the public with an ample supply of pure water. A bill for that purpose has been brought in, and referred to a select committee. It is a bill of what is called a hybrid character, and the committee, therefore, consists half of ordinary members and half of members chosen by the Committee of Selection. I have great hopes that this bill will become law before the end of the session. I trust it will prove a satisfactory measure, and that it will carry into effect some of the recommendations of the committee to which the noble lord referred. I hope that we may be able to pass the bill this session, and thus ensure at least a liberal supply of water, and that next year a bill may be introduced which may give greater powers for securing both the quantity and the quality of our water supply.

Lord TRURO: My lords, from what the noble earl has said, I should infer that to improve the quality of the water supplied to the public is of even greater importance than to increase its quantity.

Viscount HALIFAX: The bill before your lordships will, as it stands, provide both a constant supply and water of a better quality.

The subject then dropped.

FRIDAY, AUG. 18.

The METROPOLIS WATER Bill was reported from the Select Committee.

SATURDAY, AUG. 19.

The METROPOLIS WATER Bill was returned from the Commons, with the amendments agreed to.

MONDAY, AUG. 21.

The METROPOLIS WATER Bill received the Royal Assent.

HOUSE OF COMMONS.

(*Before Viscount* BURY, *Chairman; Mr.* WATERHOUSE, *Colonel* STUART, *and Sir* JAMES STRONG.)

EDINBURGH AND DISTRICT WATER BILL.

(*Continued from page* 618.)

WEDNESDAY, MAY 3.

J. F. Bateman, Esq., further examined by Mr. POPE.

The mills at Selkirk are about 16 miles by the river below the outlet of St Mary's Loch, and they have a collecting area of 89,000 acres independent of St Mary's Loch. The present scheme will only affect one-fourth of the Selkirk millowners drainage area. The mills of Messrs. Brown will utilize the whole of the water that has been spoken of if they could get it. The wheels will take about 70 million gallons a day if they were working constantly, and fully supplied with water; but, judging from the measures taken and calculations made by Mr. Stewart, they will practically take only 50 million gallons a day. In point of fact, the measure of the quantity they use must be taken, not by the size of their wheels, but according to the size of the mill-lade. Messrs. Brown's mills are the second mills on the river, and they the largest of all. The water is withdrawn by a mill-lade, which first supplies some mills above Messrs. Brown's. The whole of the water has to go through the upper mill-lade and the first mill before it goes to Messrs. Brown's. In Glasgow we supply very soft water. In the year 1854, when a bill was in Parliament for bringing water to Glasgow from Loch Katrine, evidence was given by Dr. Penny to the effect that the water was poisonous, and could not be supplied to Glasgow without extreme danger to the health of the inhabitants. Upon that, and another piece of evidence, the scheme was thrown out for that year. Experiments were then instituted for the purpose of ascertaining what the effect had been in every town in the kingdom in which equally soft water was supplied. Samples of soft water were also brought from America and other parts of the world, and the result was that the Loch Katrine water could be supplied without danger to the inhabitants of Glasgow. It has been supplied, and I believe no one ever heard of lead poisoning in Glasgow, although nothing has been done to change the system by which it is supplied. There are two other towns which are proofs of the safety of supplying soft water. I refer to Inverness and Whitehaven. Both those waters act on bright lead, but the action of the water passes away in a short time. I have here a specimen of a pipe from Inverness, which, though it has been lying in my office since the year 1854, retains the coating it got from the Loch Ness water. It is painted, as it were, with a carbonate of lead, which is imperishable and insoluble in water. This is a natural protection, and no injury accrues. There is no injurious action either in Inverness or Whitehaven. I have not the least apprehension of any danger from the supply of soft water which can be got from natural sources. I have had more to do, perhaps, with soft water supplied to towns than anybody.

Cross-examined by Mr. RODWELL: I would have no objection to preserving soft water in leaden pipes and cisterns. My answer does not apply to rain water collected from the roofs of houses in towns in which there are chemical works, as it might then be injuriously affected. The Royal Commissioners of 1869 investigated the question of supplies of soft water. I differ in many respects from their report. In fact, I think they drew a wrong conclusion from the evidence before them. I have expressed an opinion that by proper pumping and other means the waste might be stopped at Glasgow, so as to render a far less quantity of water sufficient for all ordinary purposes. Therefore 50 gallons a day per head is not necessary for Glasgow if the people use care in husbanding the water. You cannot get the people to reduce the consumption, and you cannot peremptorily bring them to the careful use of the water which no doubt they might exercise. The Act for the Manchester Water-Works, obtained in 1847 or 1848, was for the supply of more than 50 gallons a head per day on the then population. The Dublin supply also was originally considerably more than 50 gallons a day per head of the then population.

Mr. RODWELL: Taking seventeen great towns in England, is not from 22 to 30 gallons the average supply of water per head per day?

Witness: It depends so much on the character of the town that I cannot answer so general a question. I may remark that the system of water-works has been greatly developed within the last 30 years. I remember the time when 12 gallons a head per day was considered an outside allowance, but the supply now generally adopted in towns in England is 30 gallons. The supply

for Aberdeen is very much in excess of 50 gallons per head per day. I forget the exact amount, but I should think there is more than 100 gallons per head. I am speaking of the right to draw water from the river Dee for the supply of Aberdeen. Steps have been taken to reduce the supply at Glasgow, but they have either not been followed up, or success did not attend them. An additional pipe has had to be laid, which, if the people had been more careful, need not have been laid for many years.

Mr. RODWELL: Have they not two-fifths more than they would use but for their extravagance?

Witness: From 11 million to 30 million gallons of water a day has been the increase since I first knew the Glasgow Water-Works.

Mr. RODWELL: If Glasgow is to be taken as a parallel and a precedent for Edinburgh, the Edinburgh people will, when this bill is passed, have the same advantages that Glasgow have?

Witness: Yes; and these are very great advantages indeed.

Mr. RODWELL: Do you recommend that means should be taken, and that corporations and other bodies should resolutely set to work to prevent waste, or do you recommend that the people should waste water?

Witness: I should think there should be the greatest care taken in the distribution of the water, because bringing water from long distances, as you must do, to large towns is very costly.

Mr. RODWELL: Would you provide for the actual wants of the population by this constant supply, or would you provide such a supply that the population might waste the water with impunity?

Witness: I would rather they wasted their water with impunity, if they had plenty, but when it is a question of economy, and they cannot afford it, or when they are not willing to go to the expense, the water ought to be distributed in the most careful manner. The estimates for the Loch Katrine works were exceeded. They were £549,000, and the cost was £690,000. We had to erect workmen's cottages at Loch Katrine, but it will not be necessary to do so to the same extent at St. Mary's Loch. The tunnels and aqueducts will not be so large as those at Loch Katrine. The dimensions are 8 feet by 8 feet at Loch Katrine, while at St. Mary's Loch they will be 6 feet by 6 feet. The most expensive tunnel at Loch Katrine was £12 2s. per yard. Then we had no fewer than twelve shafts, 450 feet deep, through much harder material than we have here at St. Mary's Loch. The first tunnel on the Loch Katrine works, which passed under 600 feet of elevation through a very hard material, was 2000 or 3000 yards long. We had four shafts 450 feet deep, and twelve shafts in all. The cost of the four shafts was £11,454; of observatories, £500; and the cost of the tunnel was £16,275. Thus it cost exactly £12 2s. a yard.

By Mr. MUNDELLA: It is necessary to include the Loch of the Lowes in this scheme in order to get the supply of 24 million gallons a day we ask for. If we had an embankment at the head of St. Mary's Loch we might get the supply from the latter loch alone. Last year was dry. It was not in many parts of the country a year of long drought, but it was a year of small rainfall. It is only in extreme seasons that the lochs would be drawn to the extreme depth. We propose to draw down St. Mary's Loch 18 feet, but in an ordinary year it would only be drawn down about 9 or 10 feet on the average.

By Serjeant SARGOOD: St. Mary's Loch will be converted into a reservoir by drawing the water from it to a depth of 18 feet. The bottom of the aqueduct must be from 3 to 4 feet below the level of the bottom of the loch. The bottom of the outlet will not be as shown in our parliamentary plan. It has been inaccurately drawn. The depth of water passing through the outlet in order to give the supply we want, will be about 3 feet. We are proposing to execute the work according to the authority given us, to vary our aqueduct 5 feet up or 5 feet down, but we shall vary it to the extent of 3 feet. That is the variation usually authorized from the deposited plans. We have not yet determined upon the mode of construction of the outlet. In reckoning the cost I have taken the cost of the works at Loch Venacher, which is for a discharge of water from 48,000 acres, whereas this is from 28,000 acres. I have allowed for the difference of height. We have provided storeage for a drought of 180 days. The drainage area of the Ettrick and Yarrow combined is 117,000 acres. The quantity of water authorized to be taken out of Loch Katrine for the supply of Glasgow is 50 million gallons a week, and we give compensation to the extent of 40 million gallons; but it is taken from a much larger area, 48,000 acres down to the foot of Loch Venacher, as compared with 23,000 as in the case of the St. Mary's Loch district. In the Glasgow Bill there is a clause providing that if the quantity of water required to be drawn from the loch is increased, there shall be no increase in the amount of compensation. In the Loch Katrine district the rainfall is 70 inches in wet and 50½ in dry seasons, and in St. Mary's Loch district the rainfall is 60 inches in wet and 48 in dry seasons. Whenever there is more than one cubic foot per second coming off the ground, it gives so large a supply that if St. Mary's Loch were taken bodily out of the country it would not be missed. You only want so much water as Messrs. Brown's mill-wheels can use, and the quantity I have mentioned would give that without a drop from St. Mary's Loch. That is so far as Messrs. Brown are concerned. It would be different in the case of mills situate at a lower point. Messrs. Brown's mill-wheels have been chosen for this examination because I understand it is a mill with the largest wheels of any on the stream, and therefore if it is supplied, every one of the others must be. The rainfall which supplies the Ettrick and Yarrow has been taken during periods ranging from 9 to 17 years. The deficiency in the rainfall in St. Mary's Loch, in 1870, was 23½ per cent. Under ordinary circumstances, where you are going to take the whole of the water you can collect, the proper period would be the mean of two dry years for the purpose of estimating the storeage required out of which compensation is to be given. The gaugings in different other parts of country enable me to judge of the average rainfall in this one. It is a fact that the works necessary to be constructed under this bill will take four or five years in construction, and that we shall not be able to take the water before that time.

Serjeant SARGOOD: And that then you would not require to take the full supply of 24 million gallons authorized by the bill until the expiration of ten years?

Witness: Probably a longer period than that.

Serjeant SARGOOD: My object in asking these questions, as you will probably have divined, is this: We have made a proposal that observations shall be made in every possible way in which it is right to make them during the time your works are in progress, supposing the bill passes, and before you take any water, and that our compensation either for better or worse shall be regulated by the result of those observations for the four or five years. Further, that that should only be an *interim* decision, and when you have commenced to take the 12 million gallons the observations shall be resumed, and continued during the period which will elapse before you commence taking the full supply of 24 million gallons, and that upon such observations our compensation shall be based, no matter where it may land us. I want to know why that proposal is not fair?

Witness: It sounds fair enough, but would probably lead to most factious results. The same proposal was made and agreed to in 1846. I think it was by the Glasgow Water-Works Company, when they proposed to take water from Loch Lubnaig, and gauges were taken of the water discharged during the summer months of three years, but they happened to be wet summers, and the results were so entirely at variance with what was anticipated that the whole scheme was abandoned as being unworkable. Supposing, in the present case, three or four of the five summers were wet, it might give as compensation more than the whole 24 millions.

The CHAIRMAN: But supposing the summers were dry ones?

Witness: Then the millowners and other persons requiring compensation would suffer. Therefore, we had better go upon the ascertained facts which have been accumulating during thirty years.

By Serjeant SARGOOD: We are constantly adding to our information, and correcting the results of our experience of former years. The moment you give Messrs. Brown's mills all the water which they require, and which can be drawn from the river by the existing sources, beyond that would be waste to you. The landowners and other inhabitants of Selkirk are in the same boat. Their interests are similar, and I have no doubt that the least quantity of water that will run down the river past Selkirk at the driest period will be 15 million gallons. They will have a continuous flow of 10 million gallons, and, in addition to this, another 5 million gallons will be kept in reserve, and turned into the river just as the millowners require it, which will be a great advantage as compared with the state of things as at the present time. The compensation will be about a foot per second per 1000 acres, which is about the same quantity that now goes down the mill-lade during any year in which for months together the water yielded by the draining-ground will not be more than 3-10ths of a cubic foot per second, or only about a third of the quantity they would require. We shall give them three times as much as they would get under any other circumstances. The mill-lade at Messrs. Brown's is 22 feet wide at the bottom, 22 feet 3 inches at the top, and the velocity is 100 feet per minute, which gives a total flow per minute of 5080 feet.

By Mr. MACDONALD: I have calculated that of the daily 9 million or 10 million gallons about half would be impounded water. The cost of making arrangements for carrying an additional 12 million gallons at £140,000 is not included in the estimate for the works under this bill.

By the CHAIRMAN: The amount of compensation we propose to send down the mill-lade would be almost precisely the same as the present maximum supply. It would be more than equivalent, because we propose also to maintain a reserve supply equal to 5 million gallons daily, to be sent down as the millowners require. I do not think that, in addition to the quantity of water the committee has sanctioned to be withdrawn from the South Esk, there would be sufficient obtainable from that source to supply Edinburgh and the remainder of the district.

John Hawkshaw, Esq., examined by Mr. CALVERT.

In 1860 I was appointed sole commissioner to decide which of the various projects for supplying Dublin with water should be adopted. I recommended a supply from the river Vartry, and my scheme was carried out. In March last I examined the proposed schemes for supplying Edinburgh with water. I think the plan generally is extremely simple, and that as an engineering work it presents no difficulties other than very ordinary difficulties, and I believe it will afford a very good supply of water to the city of Edinburgh. There is no risk or danger of any kind that I can see. I agree generally with Mr. Bateman's evidence. I have compared the St. Mary's Loch with the Heriot and Moorfoot schemes. Of course all my comparisons were made before a considerable portion of that district had been dealt with by Parliament, and the conclusion at which I arrived then was that it would be much better that the city of Edinburgh should go to St. Mary's Loch and adopt that scheme. I consider it an important element in the comparison that the Moorfoot and Heriot schemes would necessitate the construction of large reservoirs. Where you can get a supply of water of this description without the necessity of constructing large reservoirs, that alone, in my opinion, ought to decide the question; because, although engineers undertake to make these large embankments, and ought to be able to make them safe and secure, yet we know that very serious accidents have occurred. That consideration alone ought to decide the question, even if supposing that the St. Mary's Loch scheme were more costly; and if I were asked respecting a supply of water to the city of Edinburgh, I should say, "Take the St. Mary's Loch scheme rather than run the risk of these large embankments." I have gone carefully into the estimates, and I consider the price is quite sufficient.

Cross-examined by Mr. RODWELL: The estimate for the St. Mary's Loch scheme is double that for the South Esk.

By Mr. MACDONALD: I took all the figures as regards rainfall, spring water, &c., from tables which have been shown me.

J. M. Gale, Esq., examined by Mr. CALVERT.

I am the engineer to the Glasgow Water-Works. I believe that 15 million gallons is a very proper compensation in all circumstances. The average quantity of available rain water in dry seasons in St. Mary's Loch may be taken at 36 inches, and the quantity of water to be supplied to these millowners as compensation is one-fourth of that quantity. In the case of the Loch Katrine district the available rain water in dry seasons may be taken at 48 inches, and the quantity of water to be sent down the river Teith as compensation to millowners is about 28 per cent., the difference between the two being about 3 per cent. With the maximum they have at present, and always will have, there will occasionally be a much greater quantity of water than they can use for any purpose. I never gauged the flow of the water into the mills, and therefore cannot speak as to the quantities of water which they can use. I believe the storeage in the St. Mary's Loch scheme perfectly sufficient, and capable of maintaining a supply of 24 million gallons to the city of Edinburgh, and 15 million gallons to the owners during the most severe drought that has occurred.

Mr. *H. Kirkwood*, examined by Mr. CALVERT.

I am a land agent at Glasgow, and I act in that capacity to factors on a good many estates in the west of Scotland. I have acted as a land agent for a quarter of a century, and have had great experience in the laying out of ornamental grounds. I have also had experience in the value of residential property. I have paid a visit to St. Mary's Loch lately, and carefully examined the effect which is likely to be produced by lowering the water of the lake in the manner contemplated under the powers sought by the promoters of the present scheme. The shores of the upper and lower lakes are of considerable extent, and measure about half a mile across. The surrounding country is chiefly pasturage. The scenery is very fine. The owners of the lake are Mrs. Scott, Lord Napier, the Duke of Buccleuch, and the Earl of Wemyss. Mrs. Scott has about 4600 yards of frontage; Lord Napier, 6000 yards, or thereabouts; the Duke of Buccleuch, 3330; and the Earl of Wemyss, 1500; in all, between 15,000 or 16,000 yards of lake frontage. There is a very handsome shooting-lodge, belonging to Mrs. Scott, on the north side of the lake. Judging from the eye, I should say it stood 40 or 50 feet above the level of the lake, and about 100 yards from the shore.

The CHAIRMAN: There is no oak timber in front of the house; there are two large old ash trees, and there is a very miserable cottage of two parlours at a short distance, in full view of the oriel windows. There is no gate, and it did not appear to me that there was any particular care taken of the house.

By Mr. CALVERT: Such a house would cost to build from £5000 to £6000. As far as I could judge from the nature of the shore, which is of a gravelly and shingly nature, I do not think the works would damage the amenity. If the shore were of a slimy nature, it would, no doubt, have that effect.

Cross-examined by Mr. RODWELL: I believe it is intended to lower the Lake of the Lowes, so as to afford better drainage, and that would be worth £30 per year to a neighbouring farmer. The value of the estate is some £1600 per year. I do not calculate the amount of residential injury a person sustains by the value of a house.

Mr. RODWELL: Do not you think that this house is as valuable to Mrs. Scott as if she had got a castle there?

Witness: It does not appear to me to be a place of such importance as to deserve the name of a mansion. The view from it is very pretty.

Mr. RODWELL: And is not the great feature the view?

Witness: It is the entire feature.

By Mr. MUNDELL: Mrs. Scott will be entitled to compensation under the Lands Clauses Act.

This concluded the case for the promoters.

Mr. RODWELL then addressed the committee. He said he should address himself as closely as he could to the case of the ratepayers of Edinburgh; and he ventured to say that in his experience—now rather a lengthened one—he had never seen a petition which was so honest, so genuine, and so substantial as that which had been laid by them before the committee. It contained the names of some of the first merchants in Edinburgh, and some of its most influential inhabitants were appended to it, as they were out of their own pockets paying the cost of this inquiry, to defeat what they considered to be a most unjustifiable proposal on the part of a section of the Water Trustees of Edinburgh to force upon them a scheme which neither recommended itself by economy nor by the quality of the water, and which, in point of fact, was unnecessary. In addition to the feeling displayed in that petition, which could be regarded in no other sense than as an honest expression of opinion, they had this startling fact. His learned friend, Mr. Calvert, had been guilty of an omission in this case. He knew that there was a difference of opinion amongst the Town Council of Edinburgh. He knew that this bill was promoted by a miserable majority of three out of 41 members of the Town Council, there being 19 against it, and 22 in favour of it. No doubt the Water Trustees were nearly unanimous, but that was not the point which was at present under consideration. His friend, Mr. Calvert, said this: "I will explain to you what led to this difference of opinion among the Town Council." Now, his learned friend had not offered one word of evidence upon the subject to the committee. He (Mr. Rodwell) said that differences arose from an honest feeling on the part of the minority that the proposed scheme was a bad one, and that feeling was aggravated by the knowledge that they had been treated as if they had been in that room by a species of tactics which he did not think was justifiable under any circumstances—least of all in a case where they were endeavouring to tax a large city like Edinburgh, and in which the question was whether the inhabitants should be supplied with the best description of that which was one of the greatest necessaries of life. But they did show an overwhelming feeling of dissatisfaction at the conduct of the Water Trustees, who had withheld information from them, and concealed reports which had been sent in. It was perfectly clear that when a report was unpalatable to the Water Trustees, who had formed a forgone conclusion, they kept it out of sight, as they did everything which tended to show that they were wrong. The trustees were determined upon the St. Mary's Loch scheme. Directly Mr. Leslie, whom they had appointed as their consulting engineer, thought that it was not the best or most desirable scheme, they expelled him from their councils; and instead of laying his report fairly and honestly before the public, it was suppressed by them. He should prove to the committee that the feeling against this scheme had been rising in the different wards of Edinburgh. It was only part of the manœuvres of those persons who were promoting the scheme to keep the public in ignorance of what the real effect of the bill was till it was too late to affect the deliberations. Curiously enough, however, during the time that the committee had been engaged in the discussion of this bill, a memorial had been drawn up in consequence of the evidence given by Bailie Lewis. The opposition to this bill had culminated in a memorial from the supporters of Mr. Lewis in his own ward. He did not think any bill was so strongly opposed by public feeling as the bill now before the committee. It was said that information had been given. He denied that statement, because the two most important documents in the whole of this inquiry—the reports of Mr. Stewart and Mr. Leslie—had been kept back. He ventured to say that when the committee had heard Mr. Leslie's evidence and read his report, they would be disposed to think that Mr. Lewis in his evidence committed a *suppressio veri* of which he ought not to have been guilty. Mr. Lewis stated that the reports had not been published upon the advice of the solicitor of the Water Trustees, who was charged with the prosecution of the bill. He (Mr. Rodwell) would ask them whether they were trying a *nisi prius* case before the commonest of all common juries? In a case involving the rates of Edinburgh for generations to come, was it to be said that a document must be suppressed and kept back because the solicitor thought it was advisable in the conduct of the case? Was this the way in which the citizens of Edinburgh were to be treated? It was a most unworthy course for any parties to have adopted. It was known that Mr. Leslie considered that it was not expedient that this scheme should be brought forward—that the cost was too great, and that it was not so efficient a scheme as others which might be named. Yet Mr. Lewis told them that, in his judgment, the report was not important, and they had refused to put Mr. Leslie in the box. This was sufficient to convince the committee that there lay at the bottom of all this some strong and urgent reason which drove the promoters to pursue such an extraordinary policy. The interim report went into none of Mr. Leslie's views as to the suitability of the rival schemes, and surely it was of importance to the ratepaying community to know that they could get a better scheme than St. Mary's Loch for about half the money. With regard to Mr. Leslie's evidence, and to the suppression of the documents referred to, the promoters had put the opposing ratepayers in a very unfair position. He ventured to say that it was as much due to personal feeling or personal ambition on Bailie Lewis's part as to anything else, that this bill was now before the committee. The Water Trustees had entered on the scheme with an obviously foregone conclusion. The evidence throughout had been of the weakest possible description except that of persons who were officially interested in the question. With regard to the visit of the Lord Provost and others to St. Mary's Loch, he thought any schoolboy would have known that the holes in the ice were air-holes, and that the idea of their being caused by water bubbling up from springs was absurd. The system upon which his lordship and his friends went tasting the water was one of the most primitive and barbarous he had ever heard of. The first point in which they were in accord was that there is a necessity for more water. But he qualified that observation. He did not admit that, if the water were properly distributed, and if the great waste which at present took place were stopped, there would be anything like the same demand for a new supply. The committee were asked to pass this bill for no other reason than that Glasgow had got a supply from Loch Katrine. All through the evidence Glasgow kept cropping up, and he was very much mistaken if the cause of this was not a feeling of jealousy on the part of Edinburgh. Just as one tradesman puts up plate-glass windows because another did it, so some people in Edinburgh, because Glasgow had got Loch Katrine, could not be satisfied with water that they got near hand, but thought they also should go to some distant loch. Glasgow, however, it was necessary to remember, was an altogether exceptional case. The principal cities and towns in England were satisfied with from 15 to 20 gallons a day. He was not going to ask the committee to limit Edinburgh to that extent. The city had more at present, the supply, according to some of the promoters own witnesses, being upwards of 30 gallons. Yet there were no manufactories or anything of that kind in Edinburgh to make an exceptionally large supply of water necessary. The most striking case of the uselessness of having an unnecessarily large supply was that of Norwich. This city was full of manufactories and excessively dirty streets, and had an enormous supply. Some years ago, however, an intelligent engineer went down to it, and set to work to regulate the supply, and the result was that the consumption was reduced to 16 gallons per day. Was there anything exceptional in Edinburgh to make an exceptional quantity requisite? Glasgow was a place that required far more water than Edinburgh, and Mr. Bateman himself had stated that its consumption of 50 gallons a day was extravagant. Yet the same gentleman came forward now and proposed a supply of a similar quantity for Edinburgh, thus, in the same breath, telling them that what was extravagant for the one city was not extravagant for the other. He maintained that the promoters had not shown why 50 gallons were necessary for Edinburgh, and that consequently they had failed to make out their case. Then, as to the quality of this St. Mary's Loch water, he wished to call the attention of the committee to the statements which had been made regarding it by Dr. Frankland and others. Dr. Frankland, after referring to the "Physician"—whom, by the way, he did not treat with that contempt which some of the rest of the promoters witnesses did—went on to say that although he was of opinion that St. Mary's Loch was preferable to the Talla and the Heriot, all the waters were of markedly superior quality. Dr. Alexander Wood, again, said the Heriot was a better water for general purposes than the Talla, and the spring water of both was better than the lake water of St. Mary's Loch. The questions of expense and engineering were thus those on which the case must turn, and unless the promoters could show that St. Mary's Loch was the only source that could supply the city with water, his case would be satisfactorily made out. One of the arguments in favour of the St. Mary's scheme was that twenty years hence the supply would still be abundant. He submitted, however, that it was not a fair principle to tax the present generation in order to have an unlimited supply of water for posterity. It was rather too much to call on the ratepayers to tax themselves to the extent of £12,500 for 15 years for the sake of accommodating the people. Every sixpence of money, he maintained, that was expended on these water-works which was not intended for the supply of Edinburgh with water, might be looked upon as unnecessary expenditure. In the course of his whole experience he had never seen a case where such an enormous outlay was proposed to be made for anticipated works as was done in this bill. Their first objection was to the waste of money, and a very proper one it was for the ratepayers to raise. Their next was as to the quality of the water. In coming to this part of the question, he would not say much in regard to those fleas of which they had heard so much. The promoters originally did not intend to filter the water, but now they had altered their plans. Dr. Frankland himself said that the prejudice as to the fleas was a most reasonable one, and he could not conceive anything more detrimental to the interests of a town, and more likely to drive people from it, than to let it go forth to the public that these animals abound in the water. It was all very well to say that other waters contained them, but it was important to observe that this was the first instance, out of the many thousands of samples of water which Dr. Frankland had analyzed, in which the precaution had previously been taken of straining off the fleas. Besides, all the medical witnesses had given it as their opinion that the water would be better without the fleas. Then, as to the analysis of the water, certain samples had been produced before the committee, certain analyses had been made, and certain results had been obtained. These results, no doubt, had been fairly arrived at: but he would produce other samples of water, and call Dr. Letheby and Dr. Voelcker to prove that there was a marked and distinct difference between them and those produced by the promoters. He did not at all mean to insinuate that there had been any tampering with the samples, but he intended to prove that the water of St. Mary's Loch varied materially at different times and places; and if he could show that it was liable to become impregnated so as to be unwholesome even for a single day, he thought the committee would not pass the bill.

THURSDAY, MAY 4.

Mr. RODWELL, in resuming his speech on behalf of the ratepayers of Edinburgh, said that Mr. Bateman utterly repudiated Dr. Christison's opinions as to the action of soft water upon lead, and referred to the case of Glasgow as his authority. Now, he asked the committee to adopt the views expressed by the Royal Commissioners, who examined all the scientific men of the day upon this subject, and who had this very case of the Glasgow Water-Works brought before them as an instance to show that soft water could be used with impunity, and that the Loch Katrine water had no injurious effects upon lead. He thought he should be able to show the committee that St. Mary's Loch water was liable to be coloured by peat. Mr. Bateman had told the committee that the incrustation on the lead piping would prevent any injurious action of the water, but this evidence, he must remark, was in direct contradiction to the report of the Royal Commissioners, who heard all the opinions offered by scientific men on the subject. He should call before the committee witnesses who assented as much to the doctrine laid down by the Royal Commission as Mr. Bateman dissented from it, and it was certainly very bold for that gentleman to state that because whole towns had not been poisoned by soft water there were not any objections to its use. As an illustration of the value of this kind of evidence, he might remark that a man might live next door to a powder magazine for the whole of his life and might never meet with an accident, but when an accident did happen it was an awful one. Lead was what was termed a cumulative poison, and the evil and deleterious effects of it might remain latent for a very long time. He thought it was a remarkable fact that if Dr. Christison—whose name was quoted all over Europe as an authority on poisoning—had modified his opinion on rain water, and on the minimum of saline matters which would render it safe to put it in lead, he or some other man of science had not rectified his statements on the subject. It was well known that the health of King Louis Philippe, his family, and his servants, was seriously affected in consequence of their being poisoned by the water at Claremont; and some years ago the hounds in the Royal kennel at Ascot were poisoned by water which passed through leaden pipes. With regard to the waste, he would be able to show that on an average of seven years there had been an escape of 15 gallons a head per day on a population of 250,000. This was what the book would show which the promoters had declined to produce, and yet, notwithstanding this waste, the promoters came to Parliament for power to rate the inhabitants in order to carry out a new scheme which was not required. He should show that it was the simplest thing in the world to prevent this waste, and, of course, if that were done the people of Edinburgh might have, with their present pipes and plant, an additional supply of at least 15 gallons a head per day.

The CHAIRMAN: Is not waste a recognized item of water supply?

Mr. RODWELL explained that that was waste after it had got into Edinburgh, whereas he was speaking of the waste of water which escaped over a weir seven miles out in the country. It went away to the sea without being stopped.

The CHAIRMAN: Can you prove that any waste took place at the time when the people were insufficiently supplied?

Mr. RODWELL said he could. This water might have been impounded, and used when the necessity arose. The cost of doing that would—to take the highest figure—be only one-fifth of the sum requisite to carry out the present scheme. By this means, he submitted, a sufficient supply of water might be obtained for the next 15 or 20 years. The inhabitants of Edinburgh might secure a supply of 43 gallons per day without spending any more money than was required for a reservoir. The water in the district of the Pentland Hills was infinitely superior, in consequence of the absence of peaty matter, to the water proposed to be taken from St. Mary's Loch. Commenting on Mr. Leslie's report, the learned counsel remarked that it was the ablest and most exhaustive of all the reports, but that Mr. Leslie was so diffident that he said he would rather have further information before he gave a decided opinion on the subject. There were so many facts in this case that he was afraid he had omitted some of them, but he believed he should be able to adduce evidence which would entirely alter the complexion of the promoters case. He would pass by all the points which would be raised by the other opponents of the bill, and

abstain from all arguments which would be more appropriately urged by his learned friends who appeared for the millowners and residents; but everything that he had said affected their case to this extent—that if the committee were satisfied there was no absolute necessity for the proposed scheme, they had no right to ask a landowner to sacrifice a right, even if it were only the amenities of the property he enjoyed, or deprive a millowner of any right he might possess. On behalf of the ratepayers of Edinburgh, he had put their case before the committee simply in self-defence. With regard to the letters signed "A Physician," the writer had acted with perfect independence of the opponents of the bill, had received no information from them, and had not been subsidized by them. He had no desire to put Dr. Wilson (the "Physician") forward as a witness; but, if the committee wished it, that gentleman would come forward voluntarily, and restate the conclusions set forth in his letters. He trusted, when he had laid before the committee the evidence in opposition to the scheme of the promoters, the committee would come to the conclusion at which he himself had arrived—that the scheme was a preposterous one, and that the requirements of Edinburgh did not demand that it should be carried out.

(*To be continued.*)

Legal Intelligence.

MANCHESTER CITY SESSIONS.

SATURDAY, AUG. 19.

(*Before Mr.* WYNDHAM WEST, Q.C., *Recorder.*)

Martin Sazon, landlord of the Waggon and Horses, Back Bridge Street, was charged with stealing 10,000 feet of gas, the property of the Corporation of Manchester.

Mr. TAYLOR prosecuted; Mr. HOPWOOD defended the prisoner.

Mr. TAYLOR, in opening the case, said it was a very novel one, and one which possibly a jury had never had to try before. Prisoner was the landlord of the Waggon and Horses, Back Bridge Street, and from information which the police received from a man named Macroy, who had been in the employ of the prisoner, they went to the prisoner's house in company with some of the officers of the corporation, and demanded to go into the cellar. He made some demur about not being able to find the key, and eventually the police broke open the cellar door, and it was found on examination of the meter that an additional pipe had been fixed so that the gas did not pass through the meter, and was not registered. The pipe was moveable, so that it could be taken on and off. It appeared that the prisoner was in the habit of attaching this pipe on Saturday and Sunday nights, when there was no probability of the gas officials paying a visit to the premises, and in this way he was able to reduce his gas bill of £30 yearly by about £7. A regular plumber had affixed the moveable joint on the representation of the prisoner that he wanted to attach, occasionally, an india-rubber pipe, in order to warm an adjoining beer cellar.

The evidence bore out the statement of the learned counsel, and it was elicited that the witness Macroy had been cognizant of all these proceedings, and had given information because the prisoner had threatened to prosecute him on a charge of stealing some small article. It was also shown, on behalf of the prisoner, that he had often complained of the jumping of the gas, and it was urged that this contrivance had been hit upon as a preventive. The witness Macroy was by trade a plumber, and the prisoner's barman said he had gone to Macroy the night of the prisoner's apprehension, and asked him what was to be done with the gas as it burnt badly, and it was said that the answer was sent back that the moveable pipe was to be affixed until Macroy came. The suggestion was that this was a "plant" in order to get the prisoner into the hands of the police.

The jury found the prisoner guilty, and he was sentenced to six months imprisonment.

Miscellaneous News.

THE CHESTER WATER-WORKS COMPANY.

The Twenty-ninth Half-Yearly Ordinary Meeting of Shareholders of this Company, was held at the Offices of the Company, in Newgate Street, on Thursday, Aug. 17—Mr. W. BROWN in the chair.

The report stated that the accounts showed a rather larger balance than usually remained for disposal, out of which the directors recommended a small increase in the dividend. It also stated that, owing to the efficient state of the engines, no exceptional expenditure had been called for on them during the past half year, and to this was mainly attributable the increased balance; but, under these circumstances, the directors thought it prudent to add a larger amount to the contingent-fund. The net revenue account showed a balance of £1581 0s. 4d. The preference charges amounted to £802 12s., leaving a sum of £778 8s. 4d., out of which the directors recommended that a dividend be paid, at the rate of 6 per cent. per annum, on the ordinary stock of the company, carrying forward the balance of £178 8s. 4d. to the contingent-fund.

The CHAIRMAN said there was very little for him to say with respect to the position of the company. The works had been very efficient during the past half year, and the good state of repair in which the engines were, enabled them to make some addition to the dividend on the present occasion, and to carry over a respectable balance. At the meeting of the Town Council on the previous day, he believed one of the members bore evidence of the purity and excellence of their water, and he could assure them that it had been the endeavour of the directors to make the water as good as it possibly could be. There was no doubt in the world that the water was very good, but at the same time the company must be prepared to hear a great deal said about them now that it was apparent that cholera was approaching; but he had no doubt they would be able to survive, if they met whatever might be said about them with patience. Their desire was that the water should be good and plentiful, and that there should be no stint in the supply to the town. He was happy to say that the engines of the upper works were in that condition that, if they were called upon, they could supply half as much water more than they at present supplied during the course of the day. They now did in eight hours what formerly took them twelve to do. The chairman concluded by moving that the report, together with the statement of accounts and scheme for dividends, be received and adopted.

Mr. H. LATHAM seconded the motion.

Mr. T. Q. ROBERTS said it was a very pleasing thing to be able to give to the shareholders 6 per cent. instead of 5, and he had no doubt the shareholders were very much pleased with the directors, for the works were in a very efficient state, which was mainly due to the vigilance of the chairman, who carefully looked after their interests. The result of this was that they would be able to lay by a very respectable sum for the contingent-fund, and also to pay the proprietors an extra 1 per cent.

The motion was afterwards put to the meeting, and carried unanimously.

Mr. LATHAM then moved—"That a dividend, at the rate of 6 per cent. per annum, be declared on every £100 of consolidated stock; and that the usual dividends be paid on each of the classes of preference shares, and interest, after the rate of 5 per cent. per annum, allowed on £1384, paid in respect of calls in advance on the C terminable preference shares."

Mr. TAYLOR having seconded the proposition, it was carried unanimously.

The usual vote of thanks to the chairman terminated the proceedings.

WESTERN GAS COMPANY.

The Ordinary General Meeting of this Company was held on Thursday, Aug. 10—F. W. RUSSELL, Esq., M.P., in the chair.

The report stated that the accounts for the year ending the 30th of June last, as compared with those for the previous year, showed an increase of £8152 in the gas and meter rental, and a decrease of £1071 in the return from coke and other products. The net profit of the twelve months working was £47,188 19s. 3d., the sum required for the two half-yearly dividends at the authorized rate of £10 per cent., being £39,000. The directors, therefore, recommended that dividends at that rate be declared, and forthwith paid for the second half of the financial year. The surplus of £8188 19s. 3d., remaining after payment of this dividend, would raise the reserved fund to £29,892 3s. 8d., equal to nearly 7½ per cent. on the present paid-up share capital. During the second half year the company's gas was supplied at a reduction of 6d. per 1000 feet.

Revenue.

Dr.				*Cr.*			
To Coal	£70,044	6	2	By Gas	£144,882	2	9
Supervision and labour	14,497	13	4	Meter rental	3,492	16	11
Purifying materials, water, oil, and sundries	2,715	2	5	Coke	6,798	0	4
Works renewal	5,973	0	0	Breeze	2,033	1	3
Restoring pipes and meters	5,041	6	2	Tar	3,894	18	10
Lamp-lighting	2,041	3	6	Gas liquor	856	7	10
Repairing lamps	647	10	6	Transfer fees	20	10	0
Direction and audit	1,870	0	0				
Salaries	4,047	4	11				
Collectors' commission	1,569	17	7				
Rents, rates, and taxes	2,769	11	9				
Stationery and printing	290	11	7				
Incidental expenses	772	8	1				
Bad debts	1,005	14	4				
Leasehold Redemption Fund	240	2	0				
Profit of year to June 30, 1871, carried to profit and loss account	48,452	5	7				
	£161,977	17	11		£161,977	17	11

Profit and Loss.

Dr.				*Cr.*			
To Reserved fund	£13,342	4	8	By Balance from June 30, 1870	£32,342	4	8
Interest on loans	1,263	6	4	Less dividend declared, August, 1870	19,000	0	0
First half year dividend, declared February last	19,000	0	0	Revenue account, profit of year to June 30, 1871	48,452	5	7
Balance to be appropriated	28,188	19	3				
	£61,794	10	3		£61,794	10	3

General Balance-Sheet.

Dr.				*Cr.*			
To Proprietors' capital—viz.—				By Permanent investment	£398,875	5	8
20,000 A shares (£10 each)	£200,000	0	0	Sundry debtors	29,526	7	1
10,000 new B's (£9 paid)	90,000	0	0	Stock-in-trade	12,006	8	0
10,000 C's (£9 ,,)	90,000	0	0	Reserved fund—viz.—			
20,000 D's (£1 ,,)	20,000	0	0	£23,156 0s. 2d. Consols, and half year's interest to date	21,703	4	5
New B share loan account	1,392	0	0	Cash in hand	24,458	16	8
Bonds and debentures	21,500	0	0				
Sundry creditors	12,834	17	9				
Unclaimed dividends	200	3	6				
Reserved fund	21,703	4	5				
Leasehold redemption-fund	750	16	6				
Profit (balance to be appropriated)	28,188	19	3				
	£486,570	1	5		£486,570	1	5

The report and accounts were received and adopted, the dividends recommended by the board were declared, and the retiring directors and auditor re-elected.

The proceedings closed with a vote of thanks to the chairman and directors, for their satisfactory management of the company's affairs.

THE ALUM AND AMMONIA COMPANY, LIMITED.

The Twelfth Ordinary General Meeting of the Shareholders of this Company was held at the Works, Bow Common, on Friday, Aug. 25—A. A. CROLL, Esq., in the chair.

The SECRETARY: (Mr. T. Guyatt) having read the notice convening the meeting, the following report was presented:—

The directors have the pleasure to lay before the shareholders the balance-sheet, duly audited, showing the position of the company on the 30th of June last.

From this it will be seen that the result of the year's working is satisfactory, notwithstanding the extraordinary depression of the trade in tar products. The directors, however, trust that the crisis in tar products is passed.

A new contract has been made, for seven years, with the Corporation of Glasgow, for the supply of ammoniacal liquor and tar, and a better prospect presents itself for the ensuing year, from the operation of this contract. The company has suffered, in Glasgow, to a large extent in the past year. The directors succeeded in getting an allowance of £700 from the Corporation of Glasgow, which, however, is only very partial and inadequate compensation.

During the past year a larger sum than ordinary has been expended in the renewal of plant at the several works of the company, and as usual has been charged against current revenue.

The balance to be now dealt with, after charging revenue with the amount of the interim dividend paid in February, is £12,749 18s. 4d.

The directors therefore propose to pay the usual dividend at the rate of 10 per cent. per annum, free of income-tax, making with that paid in February, 10 per cent. for the year, and leaving a balance of undivided profits of £8562 10s.

The stock account at the works in Glasgow is verified by Mr. Nicholson, and at the works in London by Mr. Odling.

The CHAIRMAN: Gentlemen, I will now formally move—"That the report and accounts circulated among the shareholders be received, adopted, and entered on the minutes." It will be observed by the accounts that after paying 10 per cent. dividend for the twelve months ending June, 1871, the balance of undivided profit is £8562 10s.; or, in other words, upwards of £1200 more than it was this time last year. The results, I think you may be assured, from the care taken by the directors in valuing the stocks belonging to the company, and verifying the balances in the books, are such as may be thoroughly and entirely depended upon. The profits which the accounts exhibit have been thoroughly and honestly earned, but I am bound to say that, having regard to the price obtained for the alum and other products manufactured by the company, the profits unquestionably ought to be considerably larger. The reason they are not larger may be found in two circumstances. The first is, that at these works something like £1800 have usually been expended in maintenance, but during the past year this has been exceeded by nearly £1000, and I have no doubt you have observed, from the inspection you were able to make this morning, that they exhibit great stability and the utmost repair and good condition. During the current year, therefore, we expect the expenditure under this head will be considerably less than is ordinarily the case. But the profits of the past year have also been diminished from

another cause. You know that this company had a contract with the Glasgow Gas Company for the tar and ammoniacal liquor produced at their works, which contract would have expired in 1872. According to that contract this company were to receive the whole of the ammoniacal liquor manufactured at the Glasgow works and a certain portion of the tar. Those gentlemen among our shareholders who are gas engineers will understand what I mean when I say that the tar we were to receive was not the tar produced from the hydraulic main, but the tar produced from the condensers and washers, the gas company using the tar produced from the hydraulic main for fuel upon their own works. The difference between the one description of tar and the other is this, that the tar from the condensers yields about treble the quantity of naphtha that the other does. For this tar, which was rich in naphtha, we paid a higher price in proportion to its value per 100 gallons. When the Corporation of Glasgow purchased the gas-works in that city, they very naturally had their own views of the mode of manufacturing gas, and their engineer decided at once to give up the use of tar for fuel, and to dispose of the whole of this product to the contractors. Without, no doubt, sufficiently thinking of the effect it would have upon this company, they commenced sending it in to us with the other tar, so that we were paying for the mixture of the higher and lower quality the price which had been fixed upon as the value of the former. When it was discovered by us, the matter was represented to the corporation, and the result of our negotiations has been the arrangement of a new contract. According to this contract we take the whole of the tar and ammonical liquor made at their principal station adjoining our works, but instead of paying so much for the tar and so much for the ammoniacal liquor—an arrangement which involved all the intricacies of testing every delivery of these products—we now pay a certain sum per ton for the coals used. I may state that these terms are, at any rate, better, taken as a whole, than the terms we had before, either with the gas company or with the corporation. Most unfortunately, however, for us, just about the time of the commencement of this contract, the Corporation of Glasgow found it desirable to increase their works, and while doing so the whole of the manufacture was disarranged, which affected us in this way. In the construction of their tanks and retort-houses it was necessary to make deep excavations into which the surface water collected, and the ammoniacal liquor and tar were sent in to us in a condition in which they were of very little use, the cost of evaporating being greater than the value of the results obtained by us. I am happy to say that all this is now remedied, and things are working more satisfactorily. I only refer to these matters as explaining why last year our accounts do not show a better result. The Corporation of Glasgow allowed us £700. It was far from being an adequate compensation, but we felt it was better to accept that sum, and remain on the best terms with the corporation and their officers, especially as we had something to look forward to in the future. I have said that but for these circumstances our profits would have been larger, and perhaps you will say, or, if you do not, some people will no doubt say to you that, seeing we pay the proprietors 10 per cent., and add £1200 to our undivided profits, after laying out £1000 additional upon the works, we ought to be content. We are content. At the same time, the prices of products have been so good that we cannot help feeling that we ought to have realized more. Well, gentlemen, there is nothing particular in the accounts to which I need refer. I may, perhaps, mention that the market for pitch and naphtha was at one time excessively low, and our stocks were very large. Since our stock at Glasgow was taken, I am happy to say an improvement in value has been effected, and we have already sold some part of those products at a higher price than that at which we valued them, proving that we were right in keeping them rather than converting them at once into cash. We have reason to believe, from the information we have received during the past week, that naphtha will ere long, in all probability, increase in value. With these remarks, I move the adoption of the report.

Mr. NICHOLSON seconded the motion, which was put, and carried unanimously.

On the motion of Mr. WILBRAHAM, seconded by Mr. HAMMOND, Mr. Nicholson, one of the retiring directors, was re-elected.

On the motion of Mr. FLOWER, seconded by Mr. POTTER, Mr. Odling was re-elected a director.

The retiring auditor was re-elected.

The CHAIRMAN: I do not think there is any other business to come before the meeting, but I feel that we ought not to separate without passing a vote of thanks to our secretary. In moving it, I can only repeat what I have frequently said before as to his ability and energy. He does not lose in our estimation, but rather gains year by year, and I have much pleasure in asking you to pass this vote.

Mr. JOHNSON seconded the motion, which was carried unanimously.

The SECRETARY: Mr. Chairman and gentlemen, I thank you very heartily for this kind expression of your opinion, and can only assure you that my best exertions shall be given to carry out the wishes of the board, and to promote the success of the company.

On the motion of Mr. BRADING, seconded by Mr. POTTER, a cordial vote of thanks was given to the chairman and directors for their continued attention to the business of the company.

The CHAIRMAN, in acknowledging the vote, said: I am sure the directors are most gratified by the kindness of the meeting in passing this resolution. It is our anxious desire to serve you to the best of our ability, but do not let the fact keep you away. We are at all times happy to see you, and it encourages us in our efforts.

A vote of thanks was given to the auditor for his services, and the proceedings closed with an intimation that the dividend warrants had been prepared, and could be had by the shareholders as they left the meeting.

THE ESTIMATION OF SULPHUR IN COAL AND COKE.

By F. CRACE CALVERT, F.R.S.

[Read before the British Association, Edinburgh meeting, section B.]

Having for many years observed the analyses of the amounts of sulphur existing in coals and coke, as published in various works, I have come to the conclusion that the difference observed in the amounts of sulphur found in the same coal by different chemists is not due so much to a difference in accuracy, or wide differences of samples, as to the various methods adopted to determine the weight of the sulphur. Without entering into the merits of the various processes which have been proposed to effect this object, I only wish in this paper to point out sources of error attending the method which I believe to be most usually adopted, which consists in adding to an oxidizing *aqua regia* a known weight of very finely powdered coal or coke, leaving it to be digested at a moderate temperature until the whole of the sulphur is supposed to be converted into sulphuric acid, then driving away the great excess of acid, boiling with water, filtering, washing the carbonaceons residue on the filter, and determining the amount of sulphuric acid in the filtrate.

In operating in this manner, there are three serious sources of error. The first is, that the sulphate of lime, which many coals contain in considerable proportion, may mislead the analyst, owing to its solubility in water being much increased by the presence of free acid. The figures usually obtained include the sulphur combined with the calcium, as well as that existing as pyrites in coal, or sulphuret of iron in coke. It is, however, most important, in a metallurgical point of view, to give the figures separately, for the sulphur combined with the calcium, as sulphate of lime, will not leave its strong base to deteriorate the quality of the iron, either in the blast-furnace or in any of the subsequent processes of manufacture; whilst the pyrites, although losing part of its sulphur as sulphurous acid, mixes as monosulphuret with the iron, and seriously lowers its commercial value.

It appeared to me, therefore, important to devise a method by which the amounts of sulphur, combined with calcium and iron, respectively, could be determined, and the following process I found to be successful:—The finely pulverized coal or coke is boiled for about twenty hours with water containing an equal weight of coal or coke taken. By this means the sulphate of lime or sulphuret of calcium is decomposed, whilst the sulphuret of iron remains unattacked. The residue is then filtered, and rapidly washed with boiling water. If a coke has been taken, nitric acid, in slight excess, must be added to the filtrate to convert the sulphuret of sodium into sulphate, and the sulphuric acid determined in the usual manner. The sulphur found in the residue will then represent the amount present in the coal or coke as pyrites or sulphuret of iron.

The value of a coal or coke for use in the iron manufacture may easily be seriously miscalculated if this difference is not taken into consideration, as may be seen from the subjoined table, which gives the figures found in six samples sent to my laboratory for analysis. It will be seen that by the usual process the coals would be condemned as unfit for use in the manufacture of iron, while, in fact, they are well adapted for that purpose:—

	Old Process.		New Process.		In Washings.		
	Sulphur per Cent.	Mean.	Sulphur per Cent.	Mean.	Sulphur per Cent.	Mean.	Difference between Processes.
1.	1·36 1·40	1·38	0·60 0·58	0·59	0·79 0·78	0·79	0·79
2.	1·59 1·55	1·57	0·63 0·67	0·65	0·97 0·95	0·96	0·92
3.	1·78 1·73	1·75	0·89 0·85	0·87	0·85 0·88	0·87	0·88
4.	1·37 1·38	1·38	0·50 0·53	0·52	0·98 1·00	0·99	0·86
5.	1·41 1·42	1·42	0·54 0·56	0·55	0·91 0·94	0·93	0·87
6.	1·58 1·60	1·59	0·68 0·70	0·69	0·97 0·99	0·98	0·90

The second objection to the method of analysis above given is, that, if the evaporation of the *aqua regia* be carried too far, a subsulphate of iron is sometimes formed, which no amount of boiling with water will remove from the carbonaceous mass, and the chemist may thus obtain too small a quantity of sulphur in the coal or coke under examination.

The third objection is, that in an acid liquor, especially if any nitric acid be present, the amount of sulphur found will always be much below the actual quantity present, owing to the fact that the formation of sulphate of baryta is, in some measure, prevented by the presence of the acid, the proportion, of course, varying with the concentration of the acid. Thus, I showed some years since that the non-formation of sulphate of baryta could reach the large proportion of 14 grains of sulphate of baryta in 1000 grains of nitric acid, of sp. gr. 1·21—an amount greatly exceeding that produced from the sulphur usually found in 100 grains of coal or coke.

As the amount of nitric acid left in the liquor is unknown, the extent to which the formation of sulphate of baryta has been prevented is also unknown, and, consequently, the figures obtained cannot be relied upon.

I cannot impress too much upon young analysts the importance of paying attention to the fact that the formation of sulphate of baryta is prevented by, and is in ratio to, the excess of nitric acid existing in the fluid; and the common belief that leaving the liquor to stand 24 hours overcomes the objection, is only approximately true, as only a part of the sulphuric acid is precipitated, while part remains in solution.

To avoid these two latter objections, I always, after concentrating the acid liquor, add carbonate of soda in excess, and heat to near the fusing-point. By this means the iron, silica, and alumina are rendered insoluble; the mass is then treated with water, washed well, and the filtrate made slightly acid with acetic acid. The sulphate of baryta is thrown down from this liquor immediately and completely.

If the dry oxidizing process is followed—that is, the addition of the finely pulverized coal or coke to a fused mixture of carbonate of potash and of chlorate or nitrate of potash—then two of the above objections are removed—viz., the non-formation of sulphate of baryta in an acid liquid, or the production of a basic sulphate of sesquioxide of iron; but there still remains the objection of the determination of the sulphuric acid of the sulphate of lime, together with that of the pyrites; and, further, I have never obtained a satisfactory determination of sulphur in an organic product, or in coal, when I have employed this method. There has always been a loss of sulphur.—*Chemical News.*

IMPERIAL GASLIGHT AND COKE COMPANY.

The Ordinary Half-Yearly General Meeting of the Shareholders of this Company was held at the Offices, No. 33, John Street, Bedford Row, on Thursday, Aug. 24—BARCLAY FARQUHARSON WATSON, Esq., deputy-governor, in the chair.

The SECRETARY (Mr. Harry Chubb) having read the advertisement convening the meeting, the corporate seal was affixed to the register of shareholders.

The following report and statements of account were presented, and taken as read:—

The directors herewith present to the shareholders the accounts of the company for the six months ending the 30th of June last.

The balance available for division (including the sum of £2664, 3s. 2d. brought forward from the 31st of December last) amounts to £94,869 7s. 2d., which is sufficient to pay dividends on the company's stock and share capital at the maximum rates, and leave a surplus of £1326 2s. 2d. to be carried to the next account.

The company's new Bromley works are being pressed forward with energy, and it is fully expected that they will be sufficiently advanced to provide the gas required to meet the increased demand of the winter of 1872.

Although on the transactions of the past half year the company have not quite earned their full dividend, yet, having regard to the fact that the reserve-fund has now reached its maximum amount, and that the revenue for the current six months will probably show a larger amount of profit than that for the first half of the year, the directors have deemed it right to give the consumers of gas in the company's district the benefit of a reduction of price at the earliest possible time at which it appeared to them that this abatement could be made consistently with the security of the dividend. They have accordingly announced that the price of gas supplied since the 1st of July last, will be reduced from 3s. 9d. to 3s. 8d. per 1000 cubic feet; and they entertain the hope that, when their new works are in active operation, further reductions may be made. They have, however, to point out that the outlay on those new works will, of necessity, require a large increase of revenue, in order to allow of such further abatement of price.

With a view to the raising, at the lowest rate of interest, so much of the additional capital required for the new works as is authorized to be borrowed on mortgage, the directors propose to exercise the borrowing powers of the company under their Act of 1869, as soon as the prescribed amount is paid up on the £12 10s. shares last issued; and a resolution authorizing them so to borrow on mortgage to the extent of £81,250, will be submitted to the shareholders.

It may be a convenience to the holders of the £12 10s. (1870) shares to be informed that a call of £2 10s. per share, making £7 10s. paid, will most probably be made payable on the 1st of October next.

IMPERIAL GASLIGHT AND COKE COMPANY.

Statements of Account for the Half Year ending June 30, 1871.

No. 1.—STATEMENT OF STOCK AND SHARE CAPITAL, *on June 30, 1871.*

Acts of Parliament authorizing the Raising of Capital.	Description of Capital.	Maximum Dividend authorized.	No. of Shares issued.	Nominal Amount of Share.	Called up per Share.	Total paid up.	Amount issued but not paid.	Remaining to be issued and called up.	Total Amount authorized.
17 Vict., cap. 55.	Stock.	10 per cent.	..	..	..	£1,560,000 0	..	..	£1,560,000
29 & 30 Vict., cap. 352.	Share.	7 Ditto.	26,000	£12 10 0	£12 10 0	325,000 0	..	..	325,000
32 & 33 Vict., cap. 128.	Ditto.	7 Ditto.	26,000	12 10 0	5 0 0	129,992 10	£7 10	£845,000	975,000
						£2,014,992 10	£7 10	£845,000	£2,860,000

No. 2.—STATEMENT OF LOAN CAPITAL, *on June 30, 1871.*

Acts of Parliament authorizing the Loan Capital.	Description of Loan.	Rate per Cent. of Interest.	Total Amount borrowed, June 30, 1871.	Remaining to be borrowed.	Total Amount authorized.
17 Vict., cap. 55.	Bonds for profits capitalized.	10 per cent.	£130,000	..	£130,000
	Debentures	4 to 5 ditto.	43,000	..	43,000
29 & 30 Vict., cap. 352.	Ditto	Ditto.	81,250	..	81,250
32 & 33 Vict., cap. 128.	....	..	..	243,750	243,750
			£254,250	£243,750	£498,000

No. 3.—CAPITAL ACCOUNT.

					Certified Receipts to Dec. 31, 1870.	Received since that date.	Total Receipts to June 30, 1871.
To Expenditure, to December 31, 1870			£2,012,447 3 6	By Consolidated Stock (1871) (formerly £50 and £10 Shares) . .	£1,545,735 0 0	£14,265 0 0	£1,560,000 0 0
Since that date—				Ditto £12 10s. Shares (1866) . .	325,000 0 0	..	325,000 0 0
Land	£17,165 0 9			Ditto £12 10s. ditto (1870) . . .	65,000 0 0	64,992 10 0	129,992 0 0
New buildings and machinery in extension of works	47,084 5 11				£1,935,735 0 0	£79,257 10 0	£2,014,992 10 0
New and additional mains and services	8,413 0 5			Bonds for capitalized profit . .	130,000 0 0	..	130,000 0 0
		72,662 7 1		Debentures	124,100 0 0	150 0 0	124,250 0 0
Total expenditure.		£2,085,109 10 7			£2,189,835 0 0	£79,407 10 0	£2,269,242 10 0
Balance		184,132 19 5					
		£2,269,242 10 0					

No. 4.—REVENUE ACCOUNT.

To Manufacture of gas—				By Sale of gas—		
Coals, including dues, carriage, unloading, &c.	£143,115 15 4			Per meter (1,451,332,000 feet, at 3s. 9d. per ton.	£268,225 13 7	
Purifying materials, oil, and sundries . . .	3,341 13 6			Public lighting and under contracts	34,973 4 11	
Salaries of engineers and officers at works . .	1,997 10 0					£303,198 18 6
Wages (manufactory)	23,397 5 10			Meter-rental		6,898 8 3
Repairs and maintenance of works and plant, machinery, apparatus and tools, materials and labour—less £1115 8s. 9d. received for old materials	46,409 0 1			Residual products—		
		£218,261 4 9		Coke, less charges, and £1403 15s. 5d. loss on breeze	46,018 8 0	
Distribution—				Tar	5,560 10 0	
Salaries and wages of officers connected with distribution	4,641 19 2			Ammoniacal liquor	3,056 8 11	
Repairs, maintenance, and renewals of mains and services, including materials, paving, and labour	3,775 17 0					54,635 6 11
Meters—repairs and renewals	4,632 17 7			Rents receivable		656 6 6
		13,050 13 9		Transfer fees		52 2 3
Public lamps—						
Lighting and repairing		6,983 12 4				
Rents, rates, and taxes—						
Rents payable	1,106 10 4					
Rates and taxes	8,739 3 4					
		9,845 13 8				
Management—						
Directors allowance	£2,000 0 0					
Company's auditors	78 15 0					
Salaries of secretary, accountant, and clerks .	4,412 0 6					
Collectors commission	4,333 11 7					
Stationery and printing	1,823 19 6					
General charges and incidentals	1,149 6 2					
		13,797 12 9				
Law charges		165 19 6				
Bad debts		2,767 0 9				
Gas referees and official auditor	740 18 9					
Public testing-offices.	253 12 2					
		994 10 11				
Total expenditure		265,866 8 5				
Balance, carried to profit and loss account (No. 5)		99,574 14 0				
		£365,441 2 5				£365,441 2 5

No. 5.—PROFIT AND LOSS ACCOUNT (NET REVENUE).

To Interest on bonds and debentures, to June 30, 1870	£9,430 16 6	By Balance from last account	£90,414 3 2
Ditto on temporary loans	64 11 6	Less dividend for the half year ending Dec. 31, 1870	87,750 0 0
Balance	94,869 7 2		£2,664 3 2
		Amount from Revenue Account (No. 4)	99,574 14 0
		Interest on moneys deposited	42 15 9
		Dividends on reserved and contingency funds, invested in Consols.	2,083 2 3
	£104,364 15 2		£104,364 15 2

No. 6.—RESERVED FUND.

To Balance	£81,250 0 0	By Balance from last account	£81,250 0 0

No. 7.—CONTINGENCY-FUND.

To Balance	£50,000 0 0	By Balance from last account	£50,000 0 0

No. 8.—STATEMENT OF COALS.

Description of Coal.	In Store, Jan. 1, 1871.	Received during Half Year.	Carbonized or used during Half Year.	In Store, June 30, 1871.
	Tons.	Tons.	Tons.	Tons.
Newcastle	24,356	159,602	173,580	10,378
Cannel	3,287	11,353	11,023	3,617
	27,643	170,955	184,603	13,995

No. 9.—STATEMENT OF RESIDUAL PRODUCTS.

Description of Residual.	In Store, Jan. 1, 1871. Estimated.	Made during Half Year. Estimated.	Used in Manufacture during Half Year. Estimated.	Sold during Half Year.	In Store, June 30, 1871. Estimated.
Coke—chaldrons of 36 bushels	9,758	184,524	45,644	145,288	3,350
Breeze—chaldrons	1,469	22,076	..	22,924	621
Tar—gallons	309,002	1,642,427	223,920	1,470,187	257,322
Ammoniacal liquor—butts of 108 gallons	1,053	22,093	..	21,358	1,788

No. 10.—BALANCE-SHEET.

To Capital, for balance per account (No. 3)	£184,132	19	5	By Amount invested in Three per Cent. Consols—		
Reserved fund, for amount of account (No. 6)	81,250	0	0	Reserved fund	£81,250	0 0
Contingency-fund, ditto (No. 7)	50,000	0	0	Contingency-fund	50,000	0 0
Interest due to June 30, 1871, on bonds and debentures	9,430	16	6	Cash at bankers and on deposit	155,721	6 8
Sundry tradesmen and others, for amount due for coals, stores, &c., to June 30, 1871	45,494	15	7	Gas and meter rental, for amount due to company, to June 30, 1871	131,775	15 8
Profit and loss, for balance of account (No. 5)	94,869	7	2	Coke and other residuals, ditto	8,434	2 9
				Sundry accounts, ditto	4,686	9 1
				Coals, for stock on hand	12,157	4 0
				Coke and breeze, ditto	1,293	0 10
				Tar and ammoniacal liquor, ditto	1,250	10 7
				Sundry stores, ditto	18,609	9 1
	£465,177	18	8		£465,177	18 8

I have examined the above accounts, and certify them to be correct. W. Hawes, *Auditor*.
I hereby certify that the above accounts are correct, and that there are no losses or forfeitures to be deducted from the maximum dividends. Chas. H. Parkes, *Official Auditor*.

The Chairman: Gentlemen, in the unavoidable absence of our governor, the performance of the duty of presiding at this meeting of the company devolves upon me, and consequently I have now the pleasure to move, according to custom—"That the report be received, adopted, and entered on the minutes." In doing so, I have very few remarks to make, and therefore shall not trespass many minutes upon your valuable time. In reference to the accounts, I may observe, in the first place, circumstances of a very cheering character—viz., that upon a comparison with the accounts for the corresponding period of last year there is exhibited an increase in the rental for gas of £33,708. We have also been fortunate in our expenditure for coal, inasmuch as though during the past six months we have carbonized 12,000 tons more than in the corresponding period of last year, our expenditure on this item is only increased by a sum under £5000. These are the cheering facts with regard to the accounts, but, on the other hand, I am sorry to have to tell you that our coke returns are by no means so productive as we could wish. No doubt this arises from causes, some of which must be very evident to you as men of business. Cheap coal will, of course, tend to bring down price in the coke market, and, in addition to this, I am rather disposed to think that the supply of coke is increasing in a greater degree than the demand. The third paragraph in our report to-day informs you that the company's new works at Bromley are being pressed forward with energy. That is certainly the case; they are works of a very comprehensive character, and will well repay a visit if any gentleman present is disposed to make an inspection of them. And they are not only extensive, but, as you may well suppose, they are very expensive, and during the progress of their construction the capital which is invested in them is necessarily unproductive. The fourth paragraph in the report relates to the reduction in the price of gas, which the directors have considered it advisable to make. One penny reduction per 1000 cubic feet seems at first sight but a very small matter, but it takes a very large sum from your revenue—in the year amounting to no less than £12,000. Still the directors have always the desire to reduce the price of gas whenever they can do so with anything like safety to the interests of the shareholders; and, taking into consideration especially the fact that they have the reserve-fund to fall back upon in case of need, they have taken the earliest opportunity of announcing the reduction to which this paragraph refers. The fifth paragraph relates to the raising of money. The directors think it is desirable to take your authority to do so, at the same time not binding themselves to raise it in the manner proposed in the report. If upon further consideration it should be thought preferable to raise it on debenture stock, or in any other way, it will be necessary to call you together at a special meeting. In the meantime the directors will be obliged to you to pass the resolution which will be proposed on the subject to-day, leaving it to their discretion to act upon it. The sixth paragraph is as to the call. We give you the earliest intimation we can respecting it; we believe the call will be made on the 1st of October. I do not know that I have anything further to say, except that I am quite prepared to answer any question which may be put to me, and therefore I conclude by moving the resolution for the adoption of the report.

Mr. St. George Burke seconded the motion.

A Proprietor: May I ask, with reference to the raising additional capital, whether we might not issue new shares instead of borrowing money on mortgage?

The Chairman: That is a matter which, of course, the board have considered; but, however much, personally, we might wish to raise the money in the way suggested, we believe that it would be undesirable to do so.

The motion was put, and carried unanimously.

The Chairman moved—"That the following dividends be now declared out of the net profits of the undertaking for the half year ending the 30th of June last—viz., at the rate of 10 per cent. per annum on £1,560,000 consolidated stock; at the rate of 7 per cent. per annum on 26,000 £12 10s. shares of 1866, fully paid; at the rate of 7 per cent. per annum on 26,000 £12 10s. shares of 1870, on which £2 10s. per share was paid from the 1st to the 31st of January, and on which £5 was paid from the 1st of February to the 30th of June; and that the dividends, as above, be made payable on Friday, the 1st of September next."

Mr. St. George Burke seconded the motion, which was put, and carried unanimously.

The Chairman moved—"That the directors be, and they are hereby, authorized to borrow, under the powers conferred by the Imperial Gas Act, 1869, any sum or sums of money not exceeding in the whole £81,250, at such times, and at such rates of interest, as they may deem it desirable."

Mr. St. George Burke seconded the motion, which was passed unanimously.

A vote of thanks was presented to the governor, deputy-governor, and directors for their continued attention to the interests of the company, and to the chairman for his conduct in the chair.

The Chairman, in acknowledging the vote, said: Gentlemen, in the name of my colleagues, and on my own part, I beg to say that we are greatly indebted to you for this vote of thanks. We duly appreciate your confidence and approval. We are desirous at all times to do our duty, and we do bestow as much pains as we can upon the affairs of the company, and look after your interests to the best of our abilities.

The proceedings then terminated.

The Rochester and Chatham Water-Works Company.—The half-yearly meeting of the shareholders was held in the National Schools, on Thursday evening, the 17th inst., Mr. J. Baird presiding. The report of the directors was a comprehensive one, referring with pleasure to the continued advancement and prosperity of the company. The profits having been, during the past half year, considerably in excess of the amount required to pay the usual dividend, the directors had written off the further sum of £800 from preliminary expenses, and they looked forward soon to see the time when this charge upon the revenue would cease. They directed that a dividend at the rate of 6 per cent. per annum (free from income-tax) be declared upon all shares for the half year ending June 30, 1871, and that such dividend be payable on the 20th of September next, and that the sum of £323 4s. 10d., the balance of the revenue account, be carried forward to the next half year's account. The cash account showed that £46,045 had been received on the capital account, the whole of which had been expended. The revenue account showed that the sum of £3656 17s. had been received for water during the past half year, leaving, after paying £800 off preliminary expenses, and the whole of the expenses of the company, a sum of £1098 available as dividend. The reserve-fund of the company now amounts to £2477. The report was unanimously received and adopted.

The Water Supply of Chester.—A short time since the *Pall Mall Gazette*, referring to the apprehension of cholera, stated that four or five years ago the borough of Chester was supplied with water from the Dee, and that before it reached Chester the sewage of Llangollen, Wrexham, Farndon, Holt, and several smaller places, was poured into it. At Chester, the part of the river from which the water was drawn was further contaminated "by being the receptacle of the sewage of the whole of the borough of Chester itself." On this question the *Pall Mall Gazette* added: "We trust all this has been remedied, for the report of the registrar of Great Boughton stated that steps had been taken with that object. We have, therefore, less hesitation in concluding in the very words of the registrar: 'This part of the river'—speaking of the company's immediate source—'is formed into a sort of lake, about one mile in length, by some 60 or 80 yards broad, bounded at the lower end by a stone causeway, erected for the purpose of holding up the water to supply the mills, and at the upper end by the shallows of Boughton Fords. Into this basin the drainage of the town is carried by at least four several sewers at different points, and in its depths lie the accumulated filth of generations, but from it is taken the whole supply of water for the city. It is horrible to think of 30,000 human beings having been condemned to the daily consumption of such water.'" This article gave rise to a very animated discussion at a meeting of the City Council, a copy of the *Pall Mall Gazette* having been sent to the chairman by the Lord Bishop of Chester. One of the members, Mr. Farish, said that the water that week had been analyzed, and that, so far as the supply to the city was concerned, it was unexceptional. Another member of the board said he entirely concurred with every word stated in the article. The state of the river from the causeway from Boughton was, he said, a nuisance to the city, and was becoming worse every year. The river was getting worse from year to year, and as a fresh portion of the sewage sank to the bottom, and was not discharged by freshets or high tides, in time it must be forced upon them to find another outlet, and the only question was whether they would do it in time or be compelled to do it. Mr. W. F. Ayrton had no doubt respecting the water of the Dee being polluted as described, and that there were sources of pollution which had not been referred to. He was very glad to hear from Mr. Farish so good a report of the quality of the water, for it was not always the case that the water was good. That, however, was not the fault of the water-works company, because the pollution arose from substances which were borne into the water, and no amount of filtration could get rid of them. Sometimes there was a flavour of petroleum, and other equally unpleasant liquids, from the water, which no amount of filtration could remove. In support of that he had only to refer to what occurred the other day at the assizes with respect to Lord Chief Justice Bovill. His lordship asked Mr. Swetenham why the water provided at his luncheon tasted so much like petroleum. Mr. Swetenham at once told him that it was in consequence of the pollution of the water by the river Alyn, and when there was a scarcity of water in the Dee that noxious flavour would arise, and no filtration would remove it. Mr. T. W. Jones advocated the sinking of wells, but this was opposed by Mr. Gerrard as impracticable, in consequence of the number of cesspools that existed. Ultimately it was resolved that the thanks of the council should be accorded to the Lord Bishop of Chester for his letter calling attention to the matter, which was now referred to a committee for further consideration.

NORTH BRITISH ASSOCIATION OF GAS MANAGERS.

Annual Meeting in Edinburgh.

The Tenth Annual General Meeting of the North British Association of Gas Managers was held in the Hall of the Royal Scottish Society of Arts, George Street, Edinburgh, on Wednesday, July 19. There was a large attendance. Hugh Bartholomew, Esq., President of the Association, Glasgow, occupied the chair.

The Secretary (Mr. Wm. Mackenzie) read the minutes of the last annual meeting, and also of the intervening committee meetings, which were unanimously approved of.

election of office-bearers.

The following office-bearers for the current year were then proposed, and unanimously elected:—

President, Mr. J. K. Watson, Edinburgh.
Vice-President, Mr. B. M. M'Crae, Dundee.
Hon. Sec. and Treasurer, Mr. Wm. Mackenzie, Dunfermline.
Committee, Messrs. T. Whimster, Perth; G. F. Cusiter, Dalkeith; G. R. Hislop, Paisley; and G. Boyd, Alloa.
Auditor, Mr. W. Fraser, Inverkeithing.

Mr. M'Crae: It is of great benefit to the association that the committee should be as wide-spread as possible. We have a wide platform, and I should like to see a number of west-country managers not only members, but taking an interest in the association.

Mr. Whimster: If we could get more managers from the west amongst us, they could also induce young men to come, who might aid us materially in furthering those interests which we are met here to promote.

the secretary's gratuitous services.

Mr. J. Reid (Leith): The meeting, I think, should now take into consideration the obligation which they owe to Mr. Mackenzie for the services he has given gratuitously to the association. He has, as you are aware, conducted the correspondence, and attended all the committee meetings, without any remuneration whatever, and my impression is that the association should agree to vote a small sum for his gratuitous services. I believe that a small sum, even though it were only nominal, would be gratifying to us all, and I think it would be well for the committee to consider what amount they might allow for the purpose.

Mr. Whimster: I would call the attention of the committee to this special point, that Mr. M'Kenzie has all the meetings to attend, whenever they are held, and he is, in consequence, at very considerable expense in doing so. This should be regarded in making some acknowledgment of his services.

The Chairman: It is impossible, in a large meeting like this, that we can go into details, and I think you should just leave the matter to the committee.

Mr. Reid: I would suggest that the committee should vote a given sum.

The Chairman: I am afraid the funds of the concern are not such as to warrant that just now.

Mr. Fraser (auditor): I may mention that we have £15 in the bank.

Mr. Mackenzie: Including the prize money, we have £25. I beg to thank you for this renewed mark of your esteem, though I am still very anxious to get some relief from my duties. Not that they are a dislike to me; on the contrary, I have always felt a pleasure in discharging them. But what I object to is, that I cannot give them that amount of attention which they would require. If no one has anybody to propose, however, I shall be glad to take office again, on this distinct understanding, that no sum be voted as remuneration.

Mr. Hyslop: I think it would be better to put it in the form of expenses for the secretary during the year.

The subject then dropped.

next annual meeting.

It was unanimously agreed, on the motion of Mr. Reid, seconded by Mr. Mackenzie, that the next annual meeting be held in Perth, on Friday, the 20th of July, 1872.

new members.

Five gentlemen were nominated, and duly admitted as members of the association.

president's address.

The Chairman then spoke as follows: I would have preferred being an ordinary member, instead of president of this association; but, since you have placed me in this arduous position, I will endeavour, in common with my predecessors in office, to set down a few thoughts, that may not prove altogether uninteresting to you. In the first place, then, I shall call your attention to the saving of fuel for furnaces—a matter which is, I consider, one of the most important features connected with the manufacturing of gas. The construction of the oven and furnace should at all times be carefully attended to, for I find that in many works the cost of fuel is the sole cause of the company paying small dividends. At one period, as most of you, I dare say, are aware, tar was used as fuel, but this was for the purpose of getting rid of the tar on account of its not being saleable. In a well-conducted work where three retorts and upwards are placed in each oven, the coke that can be disposed of with the liquid products ought at least to realize 5 per cent. on the capital where cannel coal is exclusively used; but in England, where common or coking coal is exclusively in use, much higher results will be obtained. The shape of the retorts is, in my opinion, of little importance, whether they be round, oval, kidney, or D shaped; the important part is the heating of them sufficiently with as little fuel as possible. The construction of works is another very essential matter in the prosperity of a concern. Were a little more taste displayed in their erection, the manager would have a pleasure in keeping them in order. The retort-house is generally too low in the roof, sometimes not exceeding 12 feet, and this causes the smoke to remain while the retorts are being charged, thus preventing the manager or men from remaining longer in the house than they can possibly help. Plenty of room is very important. The condensers, wash-vessels, purifiers, and station-meter should be on the way to the gasholders, and ought not to be returned from place to place where they have no right to be. When I speak thus, I should say that if there is any-one here who has not a plan of his works, with all the pipes for gas and water, drains, &c., laid down on it, he should not lose a day until he gets it done, for it is of the highest necessity that every manager should be thoroughly acquainted with the works he has under his charge. More care should be taken in erecting gas-works than in any other kind of works. As gas-works generally get too small, sufficient space should be left in connexion with each department, so that when additions are wanted, the original design is not damaged. The purifying of gas has been, and still is, a subject of much discussion. Though for this purpose oxide of iron is used in a good many works, principally, however, where they have a difficulty in getting quit of their waste lime, it is commonly understood that lime has been the longest in use, first in a liquid and then in a dry state. The important question is—Which is the most economical when the gas is kept at the proper standard of purity? The meter question is a subject with which we are all acquainted. Both the wet and dry meters are very perfect machines, which can be safely relied on if kept in proper order; and the duty of a gas manager is to consider their cost, maintenance, and durability, in order that he may be properly guided in their use. The unaccounted-for gas is a matter that gives great annoyance to the manager. There are many ways of accounting for it, as, for instance, in winter, when, of course, the largest quantity of gas is wanted, it is measured at a higher temperature than when a smaller quantity is wanted, and it is delivered at a lower temperature than at any other time of the year, often as low as 32°. This gives a difference of 30°, each degree producing a deduction of ·203 per cent., which, at 30°, will make a difference of 6 099 per cent. It is well known that gas passes through cast iron; and if you want to know a water from a gas pipe, you have only to smell the outside. Therefore, a company who have a large extent of pipes and a small delivery must sustain the greatest extent of loss. Meters not in proper order will indicate against the company. The quality of the gas is of great importance both to the manufacturer and to the public. It is bad economy to make a poor gas and reduce the price. Experience shows that complaints are greater as to quality than price. I have always recommended a lower heat than what is generally used in carbonizing coal, and Dr. Stevenson Macadam made a number of valuable experiments last year which showed that by producing much less gas you get nearly the same amount of light. When we consider what the companies were made for—that it was to produce a gas to give light—why should we manufacture a gas that gives so much heat and offensive fumes by the extra quantity consumed? In England, where inferior coal is used, very few people have it in their dwelling-houses from that very cause. Gentlemen, hoping that what I have said may have been of at least some interest to you, I shall now bring my remarks to a close.

Mr. Whimster proposed a vote of thanks to Mr. Bartholomew for his excellent address, which, he was sure, had directed their minds to certain points that were of the utmost value in managing gas-works successfully.

report on prize papers by the committee.

The Secretary read the following report by the committee on prize essays:—

Shortly after the last annual meeting of the association the committee proceeded to take into consideration the subjects which should be laid before the members for competition, and accordingly, at a meeting held on the 19th of October, a set of subjects was agreed upon, and a circular embracing these was prepared by the secretary and circulated amongst the members.

The committee regret to report that the response from the members to their appeal has not been so favourable as they had anticipated and could have wished for, though the papers which they have received are of considerable value and merit. They unanimously make the following awards, viz.:—

1. "On the Removal of the Impurities from Coal Gas." To the author of the paper bearing the motto "*Ab origine*," the first prize of £10.
2. On the same subject. To the author of the paper bearing the motto "*Purus*," the second prize of £6.

The committee consider that the subject of the prize papers should be taken up at an early day by the committee now to be appointed, in order that the subjects for next year may be placed before the members in as complete a form as possible.

The report was adopted.

The Secretary then intimated the following donations to the prize-fund—viz., from Messrs. D. Y. Stewart and Co., Glasgow, and Thomas Allan and Sons, Glasgow, the sum of £10.

On opening the sealed mottoes attached to the prize papers, it was found that the successful competitors were Mr. P. Innes, Gas-works, Forfar, and Mr. A. M'Pherson, Gas-works, Kirkcaldy.

the yearly subscription.

On the motion of Mr. Hyslop, seconded by Mr. M'Crae, it was unanimously agreed to raise the annual subscription for members from 3s. to 5s.

THE TRANSFER OF GAS-WORKS FROM PRIVATE COMPANIES TO CORPORATIONS.

Mr. M'Crae (Dundee) then read a highly interesting paper on the above subject, which elicited considerable comment among some of the members.

Mr. Fraser thought the paper showed in a plain, straightforward, and common-sense manner the advantages and disadvantages of gas-works being transferred from private companies to corporations. In selling works it was, he said, of great moment that a corporation should come to an amicable understanding with the gas company, and when that was not done it created a very large field for the lawyers.

Mr. Whimster: I am convinced that the spirit in which the transfer is gone into, of which we hear so much talk in some circles, is but the spirit of commerce—a spirit which prevails all the world over, and I do not see that the gas companies should be made an exception in this respect. It has also been said that the concern should be valued according to the dividend of so many years. Now, in my opinion, that would be a most unjust principle for the shareholders of certain companies. Suppose a place where, twenty years ago, an opposition gas company was started. The first company, we shall say, was to pay 10 per cent. on its capital, as the dividends of the company so started were taken away altogether. Some fighting forthwith went on between the two companies, but ultimately an understanding was come to, and the dividends were raised 5 or 6 per cent. They quarrelled, however, and fought again, and down went the dividends to nothing. Now, if you take these two companies, the original deserved as much praise as the other for risking money and supplying the community with what would not have been got otherwise. Though you might step in after a lapse of years and say the second company paid 10 per cent., I hold that the one company is as much entitled to remuneration as the other, and I would say that the company who paid 1½ per cent. should get 20 per cent. instead of 10.

Mr. M'Crae remarked that, in valuing gas-works, they should be taken upon the merits of the position they hold.

Mr. Bailey (Falkirk) moved a vote of thanks to Mr. M'Crae for his paper.

THE RELATIVE VALUE OF THE PURIFYING AGENTS EMPLOYED IN THE MANUFACTURE OF COAL GAS.

Dr. Stevenson Macadam, F.R.S.E., then delivered the following lecture on the above subject:—

The subject of the purification of coal gas is one of the greatest importance to gas engineers, and the discussion of the relative value of the agents employed for the arrestment of impurities may probably lead to some improvement or advance in that department of technical chemistry. It is well known that when coal is distilled in the retorts, the crude gas which is evolved contains many vapours and gases which it is desirable, and even necessary, to separate, before the gas is employed for illuminating purposes within doors. These vapours and gases are principally of a tar and naphtha nature, accompanied by much water, steam, and ammonia, and some carbonic acid, sulphuretted hydrogen, and other sulphur compounds.

The tar and naphtha, as well as water vapour and ammonia, are mainly arrested in the hydraulic main, tar-pit, and condensers, by the simple device of allowing the vapours to cool and condense. There is always, however, a certain proportion of the ammonia, probably as carbonate of ammonia, which, owing to the ready volatility of that substance, is still carried on with the gas, and such may be withdrawn by allowing the gas to come in contact with sulphuric acid more or less diluted with water. The strong acid does not absorb the ammonia so well, and, moreover, has a greater tendency to take up some of the heavier hydrocarbons, and thus reduce the photogenic or illuminating power of the gas. A convenient form of arrangement for using the acid is to saturate sawdust therewith, and pass the gas through a stratum of such, or to wash the gas with the dilute acid. A mixture of oxide of iron and sawdust, sprinkled with the dilute acid, has also been found eminently serviceable. The theory of the action of the acid is that it combines chemically with two parts of the ammonia to form sulphate of ammonia, and as the combining proportion of the oil of vitriol (hydrated sulphuric acid) is 98, and that of ammonia (gaseous) is $17 \times 2 = 34$, it follows that every 100 parts of the oil of vitriol take up 34 parts of the ammonia.

The formula for the action, when the true gaseous ammonia is considered, is as follows:—

Ammonia.		Sulphuric Acid.		Sulphate of Ammonia.
$2\ NH_3$	+	$H_2\ SO_4$	=	$2\ (NH_4)\ SO_4$.

and when carbonate of ammonia is arrested, the change may be represented as—

Carbonate of Ammonia.		Sulphuric Acid.		Sulphate of Ammonia.		Water.	Carbonic Acid.
$2\ (NH_4)\ CO_3$	+	$H_2\ SO_4$	=	$2\ (NH_4)\ SO_4$	+	$H_2\ O$	and CO_2

On making the necessary calculations, it will be found that 1 to 2 lbs. by weight of sulphuric acid are sufficient to remove the ammonia from the whole gas capable of being yielded by a ton of coals viz., about 10,000 cubic feet. This treatment of the gas, however, by acid, must not be carried out in elaborate or complicated washing apparatus, as the gas is liable to be injured, not only by the abstraction of luminous hydrocarbons, but also by becoming impregnated with carbonic acid vapour.

The removal of the sulphur from gas is the most important operation in the purification of gas, and one which has commanded much attention of late. The earliest method of arresting the sulphur existing as sulphuretted hydrogen was by wet lime—in other words, by lime which had been treated with so much water as to form a thin lime sludge or cream. The discharge of the spent wet lime from gas-works into ditches and streams was a great nuisance, and recourse was then had to dry lime—that is, to lime which has been thoroughly slaked with water, so as to form a damp powder. When the lime shell is first treated with water, the latter combines with the lime to form a true chemical compound of one part of the lime with one part of the water, thus:—

Lime.		Water.		Slaked Lime.
$Ca\ O$	+	$H_2\ O$	=	$Ca\ O, H_2\ O$ or $Ca\ H_2\ O_2$

The combining proportion of the lime, Ca O, being 56, and that of water, H_2 O, being 18, it follows that every 100 parts by weight of the lime combine with fully 32 parts of water.

This compound is perfectly dry, though containing water, and is a fine powder. It is too dry for the purposes of the gas manufacture, and must be damped by the addition of more water till it becomes capable of being moulded or kneaded between the fingers. Though damp, in the strict sense of the term, it is still known in technical language as dry lime. It is then in the best condition for arresting the sulphur which the gas contains as sulphuretted hydrogen. The mode in which the lime acts may be represented by the following formula, where one combining proportion of the hydrated or slaked lime, or 74 parts by weight, removes two combining proportions of sulphuretted hydrogen or $34 \times 2 = 68$ parts by weight, thus:—

Hydrated Lime.		Sulphuretted Hydrogen.		Calcic Sulphide.		Water.
$Ca\ O, H_2\ O$	+	$2\ H_2\ S$	=	$Ca\ S, H_2\ S$	+	$2\ H_2\ O$
or— $Ca\ H_2\ O_2$	+	$2\ H_2\ S$	=	$Ca\ H_2\ S_2$	+	$2\ H_2\ O$

Theoretically, therefore, 100 parts of the slaked lime should be capable of taking up fully 90 parts of sulphuretted hydrogen; but, practically, such a complete transformation of the lime never takes place, as much of it is left as the hydrated lime. Another part is acted upon by the carbonic acid of the gas forming calcic carbonate (chalk), whilst other sulphur compounds are produced, so that the spent gas lime or "blue billy" contains variable proportions of different lime compounds. The efficacy of the lime in arresting the sulphuretted hydrogen under ordinary circumstances, and when the purifiers are kept cool, cannot be denied; and the only objection of any moment is as to the disagreeable odour which it evolves on exposure to the air, especially when freshly turned out of the purifiers. The carbonic acid of the air reacts upon the calcic sulphide, and tends to liberate the sulphuretted hydrogen into the atmosphere, thus:—

Calcic Sulphide.		Carbonic Acid.		Calcic Carbonate.		Sulphuretted Hydrogen.
$Ca\ H_2\ S_2$	+	$H_2\ CO_3$	=	$Ca\ CO_3$	+	$2\ H_2\ S$

A similar change may even occur in the purifiers when the lime is retained too long, and when the carbonic acid of the subsequent gas tends to expel the sulphuretted hydrogen from the already formed calcic sulphide.

The employment of the hydrated oxide of iron in the purifiers in place of the lime has much to commend it in large works situated in crowded towns and cities, when the exact principles on which it acts are understood, and its failings are recognized. It cannot be regarded as a full substitute for the lime, because the latter not only removes the sulphuretted hydrogen, but also the carbonic acid, whilst the hydrated oxide of iron can only arrest the sulphuretted hydrogen. The oxide of iron has been proposed to be used in various ways. Thus Laming, who first suggested the use of the material in 1849, prepared it from copperas (sulphate of iron), slaked lime, and sawdust, which in time yielded a mixture of hydrated oxide of iron, stucco (sulphate of lime), and sawdust. It was afterwards suggested by Hills, that the native hydrated oxide of iron or bog iron ore might be used in place of the above mixture, and a modification has been proposed by taking the native ore, adding to it a quantity of iron filings, and after drenching them with ammoniacal liquor, we expose the whole to the air, when oxidation of the metallic iron takes place and an open, porous, and somewhat friable mixture is obtained. A similar porous mass may be procured by mingling sawdust with the native hydrated oxide of iron. Indeed, the native bog iron ore is in such a serviceable condition, that there appears no reason why recourse need be had to chemical processes for its manufacture or preparation.

The theory of the action of the oxide of iron in removing the sulphur from the gas is almost identical with that of the lime. Both are in the hydrated state, and both act by combining with the sulphuretted hydrogen and liberating water. The hydrated oxide of iron consists of the oxide of iron, $Fe_2\ O_3$, combined with water, H_2 O, as the hydrated oxide $Fe_2\ O_3\ H_2$ O or $Fe_2\ H_2\ O_4$; and when gas containing sulphuretted hydrogen is transmitted through the purifiers containing this substance, the following change occurs:—

Hydrated Oxide of Iron.		Sulphuretted Hydrogen.		Sulphide of Iron.		Water.
$Fe_2\ O_3\ H_2\ O$	+	$4\ H_2\ S$	=	$Fe_2\ S_2\ H_2\ S$	+	$4\ H_2\ O$
or— $Fe_2\ H_2\ O_4$	+	$4\ H_2\ S$	=	$Fe_2\ H_2\ S_4$	+	$4\ H_2\ O$,

Only a part of the oxide of iron is changed at a time, but that part which is so altered has the power of taking up the sulphuretted hydrogen to the extent of one combining proportion of the hydrated oxide of iron, $Fe_2\ H_2\ O_4 = 178$, arresting four combining proportions of sulphuretted hydrogen, $H_2S = 34 \times 4 = 136$, which is equal to 100 parts of the hydrated oxide of iron removing 80 parts of the sulphuretted hydrogen. The operation, however, is one which only partially occurs at any one time, mainly owing to the outside of the particles of the oxide of iron only coming in direct contact with the sulphur compound. When the oxide of iron in the purifiers has become practically charged with sulphur for the time being, it may be thrown out and exposed to the air without becoming a nuisance, and with the beneficial result that the oxygen of the air reacting thereon separates the sulphur and re-forms the oxide, which is fit again for use in the purifiers. This regeneration or revivifying of the oxide of iron is readily explained by four parts of the oxygen of air replacing the four of sulphur in the spent iron compound, and liberating the four parts of sulphur as free sulphur. Thus—

Sulphide of Iron from Purifiers.		Oxygen from Air.		Hydrated Oxide of Iron.		Free Sulphur.
$Fe_2\ H_2\ S_4$	+	O_4	=	$Fe_2\ H_2\ O_4$	+	S_4

The hydrated oxide of iron may again be used in the purifiers, time after time, till the proportion of liberated or free sulphur amounts to 40 to 60 per cent., when the iron compound may be employed as a source of sulphur or of sulphurous acid in the manufacture of oil of vitriol. The revivifying of the sulphide of iron may also be accomplished by passing a current of steam through the compound, when the oxygen of the water replaces the sulphur forming the hydrated oxide of iron and sulphuretted hydrogen. Thus—

Sulphide of Iron from Purifiers.		Water Vapour or Steam.		Hydrated Oxide of Iron.		Sulphuretted Hydrogen.
$Fe_2\ S_2\ H_2\ S$	+	$4\ H_2\ O$	=	$Fe_2\ O_3\ H_2\ O$	+	$4\ H_2S$
or— $Fe_2\ H_2\ S_4$	+	$4\ H_2\ O$	=	$Fe_2\ H_2\ O_4$	+	$4\ H_2S$

The sulphuretted hydrogen thus disengaged must be conveyed to a furnace and burned, in order to avoid the contamination of the atmosphere with the highly fœtid odour of the gas.

Whilst the hydrated oxide of iron and lime are very useful in removing sulphur from the crude gas when it exists as sulphuretted hydrogen, they are comparatively worthless as agents for the arrestment of the sulphur when it is present in other states of combination. At present the only practicable method for the removal of such is the diurnal washing of the gas with the ammoniacal liquid which is already charged with the heavier hydrocarbons, and which can take up or dissolve these other sulphur compounds without materially affecting the luminosity of the gas.

The removal of the carbonic acid from the crude gas can only be accomplished by lime. For this purpose the hydrated oxide of iron is of no service at all, and gas purified from sulphuretted hydrogen in the most rigid and careful manner by the iron compound still retains all its carbonic acid. The latter impurity has been alluded to as if its removal from gas were a matter of little moment. No doubt the presence of the carbonic acid does not confer any noxious or deleterious properties upon the gas, and may add but little to the amount of the same gas produced during combustion of the coal gas in the ordinary jets, but the loss in illuminating power due to the presence of carbonic acid is much too serious to be overlooked. One per cent. of carbonic acid reduces the photogenic or illuminating power of average gas to the extent of 5 per cent., whilst 2 per cent. of carbonic acid brings down the luminosity by 10 to 12½ per cent. Though, therefore, hydrated oxide of iron may be justly commended as an excellent arrester of sulphuretted hydrogen, the gas should always be subjected, more or less, to the action of lime, for the purpose of separating the carbonic acid. The mode in which the lime removes the carbonic acid is, that one combining proportion of the hydrated or slaked lime, or 74 parts by weight, takes up one combining proportion of carbonic acid, or 44 parts by weight, forming the calcic carbonate (chalk), and separating an atom of water, thus:—

Hydrated Oxide or Slaked Lime.		Carbonic Acid.		Calcic Carbonate (Chalk).		Water.
$Ca\ O, H_2\ O$	+	CO_2	=	$Ca\ O, CO_2$	+	$H_2\ O$
$Ca\ H_2\ O_2$	+	CO_2	=	$Ca\ CO_3$	+	$H_2\ O$

The general conclusions to be drawn, therefore, from this communication are, that the sulphur compounds (other than sulphuretted hydrogen) should be removed by thorough washing with ammoniacal liquor; the ammonia not previously condensed may be separated by dilute sulphuric acid; the sulphuretted hydrogen may be arrested by hydrated oxide of iron, or by lime, and the carbonic acid can be held back by the lime. Where the hydrated oxide of iron is depended upon for the removal of the sulphuretted hydrogen, the gas should be subsequently passed through hydrated or slaked lime for the arrestment of the carbonic acid. When properly worked, the spent lime obtained at this stage would not be offensive when exposed to the air, and could not be regarded as a nuisance even in large towns.

At the close of the lecture,

Mr. WHIMSTER said he had lately heard the subject of the condensation of gas fully discussed, and the question of naphthaline was also brought up. It was stated that, when the gas was taken rapidly out of the retort-house, naphthaline then made its appearance; but, on the contrary, when it was retained long in the retort-house, and kept in contact with the liquid products, and gradually brought down to a certain temperature, naphthaline was not known. Now that showed, in his opinion, that there was a certain portion of the richer products that seemed to be condensed by being brought into early contact with low temperatures. He would like to ask Dr. Macadam if that would have been the case, to the same extent, with Scotch gases, seeing that the power of English gases was always decreased.

Dr. MACADAM: Was the gas taken out of the retorts, and kept free, and afterwards tested?

Mr. WHIMSTER: The condenser was lowered from 60 to 100 degrees, and the gas was taken out of the retort-house immediately.

Dr. MACADAM: That is a question of naphthaline, I should fancy. In the one case, the gas is taken out of the retort-house and sent to the condensers, and then is tested; in the other, it is stopped in the retort-house for some time, and then cooled down there. What I would like to know is this: Was the gas which was transmitted from the retort-house immediately afterwards stored in the gasometer? or was the gas kept in the retort-house for some time, and then stored in the gasometer.

Mr. WHIMSTER: One of the gas-works, it was said, worked in the one way, and the other in the other. It came out in the discussion that, whenever the slow process of condensation was adopted, naphthaline was got rid of.

Dr. MACADAM: And was there much difference in the quality of the gas?

Mr. WHIMSTER: Well, I am not sure. The idea conveyed was that, by keeping the gas in contact with the liquid products, it was prevented from being impoverished by the richer portion of it.

Mr. FRASER: But that, I think, arises from the choking up of the pipes in the retort-house.

Mr. REID: The process of condensation which is employed by most of us goes on continuously. It seems very peculiar, if gas is prepared only different as respects the rapidity in which it is condensed, how the one process should yield a greater quantity of naphthaline than the other. I cannot see how that can arise.

Mr. WHIMSTER: Street-lamps have been affected with naphthaline in the one case, and not in the other, and in the same work too.

Mr. M'CRAE thought it seemed very plain that the two different results should take place.

Mr. WHIMSTER: It was my impression that naphthaline formed a valuable illuminant in gas, and made it much purer when naphthaline was found.

Dr. MACADAM: I do not suppose that naphthaline is supposed to be a purifier in gas. It makes a very smoky flame, and it would not, I think, be of advantage to Scotch gases, because they are so rich already. There is always more carbon present when there is naphthaline.

Mr. REID: I think the question which arises from this discussion is of grea importance to gas managers, and I would suggest that those who are to compete for the prize papers next year should take up the subject, and put it to the test of experiment. Considerable benefit would be derived by the association were the whole of the members to investigate the matter.

The CHAIRMAN: I do not think the subject of naphthaline would be of much importance to Scotch managers, because we have never seen it yet, and there is no great use in getting papers upon a matter with which we have no connexion in Scotland.

Dr. MACADAM: If you wish papers relating to the subject, you could say the heavier hydrocarbons present in the gas, instead of naphthaline.

The CHAIRMAN: Of course, it is the duty of the committee to make arrangements for next year's prize papers.

Mr. WATSON then proposed a vote of thanks to Dr. Macadam; after which the discussion dropped, and the meeting separated.

The association afterwards dined in the Café Royal Hotel, West Register Street, when Mr. Bartholomew presided, and Mr. George Myers discharged the duties of croupier.

REPORT TO THE BOARD OF TRADE BY THE GAS REFEREES ON THE AMMONIA IMPURITY IN GAS.

To the Lords of the Committee of Privy Council for Trade.

23, *New Street, Spring Gardens, June* 1, 1871.

The gas referees, on the 31st of March, issued a circular to the gas companies included under the Metropolitan Gas Acts of 1868 and 1869, giving notice that on and after the 1st of October next, the maximum of ammonia allowed in the gas will be reduced to one-half its present amount.

The referees take this opportunity to lay before the Board of Trade a report upon the ammonia question and their proceedings in connexion with it.

On their appointment, the referees in 1868 fixed the maximum for ammonia for the City companies (viz., those included under the Act of 1868) at 5 grains per 100 cubic feet of gas; and the same maximum was subsequently fixed by them for the Imperial and South Metropolitan Companies, on the passing of the Acts of 1869.

In prescribing the mode of testing for ammonia, the referees made it of such a kind as to show not merely whether the maximum was exceeded, but the actual quantity of ammonia each day found in the gas. By so doing, they fully informed themselves as to the amount of this impurity at each of the nine gas-works placed under their jurisdiction, with its averages, and also its daily fluctuations. This mode of testing was continued as regards the City companies up to the end of June, 1870, and in the case of the Imperial and South Metropolitan Companies it was continued until the end of March, 1871.

Monthly Averages.

In the appendix to this report will be found the records of the daily testings for ammonia since the opening of the several testing-stations. The following summary of those records shows the average amount of ammonia per 100 feet of gas for each month of the period, for each of the manufacturing stations of the companies under the Acts of 1868-9:—

TABLE I.

	Chartered Company.				City Company.		Great General.
	Westminster.		Curt. Rd.	Brick La.	Blackfriars.		Bow.
	Cannel.	Common.	Common.	Common.	Cannel.	Common.	Common.
1869.	Gr.	Gr.	Gr.	Gr.			Gr.
August	—	—	—	—	None.	None.	—
September	3·3	6·9	2·2	—	,,	,,	1·1
October	3·6	4·8	4·7	8·3	,,	,,	1·1
November	2·8	2·8	4·1	7·0	,,	,,	1·4
December	1·6	2·4	2·7	4·4	,,	,,	·2
1870.							
January	1·8	3·0	1·8	1·1	,,	,,	·16
February	2·5	3·3	·8	·8	,,	,,	·08
March	1·9	3·3	1·7	·6	,,	,,	·4
April	2·2	3·0	4·8	4·4	,,	,,	·7
May	1·8	2·5	2·5	2·8	,,	,,	·1
June	—	—	1·6	2·6	,,	,,	1·2
Total average	2·4	3·5	2·6	3·5	,,	,,	·6

TABLE I.—(*Continued*).

	Imperial Gas Company.			South Metropolitan Company.
	Fulham.	St. Pancras.	Haggerston.	Old Kent Road.
1870.	Gr.	Gr.	Gr.	Gr.
July	·3	1·4	—	·5
August	·5	3·1	—	1·0
September	·2	1·8	—	·8
October	·3	1·7	—	1·1
November	·04	1·7	—	1·1
December	1·5	2·1	—	1·3
1871.				
January	·4	1·5	1·5	·7
February	·8	1·7	1·6	·4
March	·1	2·2	1·2	·4
Total average	·4	1·9	1·4	·8

From this table it appears that although the maximum allowed has hitherto been 5 grains per 100 feet of gas, the average amount of ammonia in the gas of all the companies has been greatly below 5 grains. At the Blackfriars works the gas has been manufactured without any ammonia at all. At the works at Fulham, at Bow, and in the Old Kent Road, the gas contained on the average less than 1 grain. At the works at Haggerston and St. Pancras (where there is a lack of room), the ammonia in the gas has averaged from 1·5 to 1·8 grains; and in the gas-works at Westminster, Brick Lane, and Curtain Road, which are the oldest and most cramped gas-works in London, the average, though much higher than at the other works, was well below the maximum, being respectively 3·5, 3·5, and 2·6 grains.

As the new works of the Chartered Company at Beckton are now in operation, the two oldest manufacturing stations of this company—those at Brick Lane and Curtain Road—have been entirely closed, and ere long the manufacture of gas at the Westminster station of that company will be lightened, so that the present difficulty arising from the defective arrangement of those old works and the want of room may be considerably mitigated. The Chartered was the first established gas company—its works are the oldest of any in London or elsewhere in the United Kingdom—accordingly it is not to be wondered at that these works should have laboured under many disadvantages from which the works of the other later established companies, who profited by its experience, are more or less free.

Maximum and Minimum per Month of the Amount of Ammonia.

The monthly averages of ammonia having been given, it is requisite also to show, in the next place, the largest and the smallest amount of this impurity which has been present in the gas of the various companies during each month. Such variations, so far as they are not due to neglect on the part of the companies, have to be taken into account in fixing the maximum; for by the London Gas Acts of 1868 and 1869 the maximum for any impurity fixed by the referees must apply to every single day's testings; so that, however low may be the *average* of impurity in any company's gas, the company incurs a penalty of £50 if on any single day the maximum is exceeded. The referees consider that it would be better if the maximum fixed for impurities were made to apply to a weekly average, instead of to each single testing. The result as regards the purity of the gas would, in either case, doubtless be the same; but if a weekly average for impurities were taken, the maximum which in such a case would be fixed by the referees would better represent to the public the true state of matters. The maximum for impurities would then be fixed at a lower point than is at present possible.

The maximum and minimum of the daily variations in the amount of ammonia in the gas have been as follows:—

TABLE II.

Manufacturing Stations.	1869.								1870.											
	September.		October.		November.		December.		January.		February.		March.		April.		May.		June.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Westminster—Cannel	4·5	2·6	8·1	2·0	6·4	1·3	2·4	1·1	2·8	1·1	3·4	1·3	2·8	1·1	3·3	1·6	2·4	·9	—	—
Do. Common	8·4	5·8	6·7	2·7	4·8	1·2	3·4	1·6	4·1	2·0	4·3	2·1	4·9	2·0	4·3	1·7	3·3	2·0	—	—
Brick Lane	8·8	None.	8·9	2·9	6·8	2·1	3·6	2·0	3·2	·75	1·3	·3	3·0	·5	6·6	1·4	4·0	1·0	3·6	2·0
Curtain Road	—	—	19·6	None.	9·4	5·2	6·2	1·0	2·5	·4	1·9	None.	2·0	None.	9·2	·4	3·4	2·2	3·4	2·3
Blackfriars—Cannel	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.
Do. Common	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.	None.
Bow	2·6	None.	3·8	None.	11·0	None.	2·3	None.	1·9	None.	1·09	None.	4·8	None.	4·3	None.	1·4	None.	13·0	None.

Manufacturing Stations.	1870.								1871.					
	July.		August.		September.		October.		November.		December.		January.		February.		March.	
	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.	Max.	Min.
Fulham	3·25	None.	3·0	None.	1·0	None.	1·5	None.	1·0	None.	8·0	None.	1·0	None.	1·3	·5	·5	None.
St. Pancras	4·0	·5	5·0	1·5	2·7	1·2	2·7	·5	3·5	·2	3·0	1·5	2·2	1·2	2·8	1·0	3·5	1·0
Haggerston	—	—	—	—	—	—	—	—	—	—	—	—	2·0	·7	2·4	1·0	2·0	1·2
Old Kent Road	2·5	None.	1·25	·1	1·25	·25	1·5	·5	2·0	·5	2·0	·75	1·2	·5	·75	None.	·75	None.

Number of Times that Ammonia has been in Excess.

Lastly, as to the number of times when the ammonia maximum of 5 grains has been exceeded by any company. It will be seen from the daily testings given in the appendix, since July 1869, when the first testing-stations were opened, the gas of the Chartered Company has been 105 times in excess—namely, 25 times for its Westminster works, and 80 times for its works at Brick Lane and Curtain Road; and the gas from the Great Central Company's works at Bow has exceeded the ammonia maximum four times. Since July, 1870, however, there has been no excess on the part of any of the gas-works which supply the City (which in the latter half of that year were all amalgamated under the Chartered Company), nor on the part of the South Metropolitan Company; and only four times in the gas of the Imperial Company—viz., on four successive days at the Fulham works. Nearly all those transgressions of the maximum were due to unavoidable causes or accidents.

It will be observed, from the preceding tables, that there has been a marked improvement in the purity of the gas as regards ammonia since the Act of 1868 came into operation, especially in the old works of the Chartered Company, where there was most need for improvement, but also where the difficulties to be encountered were greatest. The diminution of ammonia in the gas manufactured at the Westminster works of that company has not been inconsiderable; and at the Brick Lane and Curtain Road works (although these were only temporarily maintained, and are now closed in conformity with the requirements to that effect in the company's Act of 1868) the directors, upon the requirement of the referees, did their best to remedy the deficiencies of those works, by heightening and improving the structure of the scrubbers (there being no room for the erection of additional scrubbers), and by supplementing the scrubbing power by the use of sulphate of iron and other appliances.

As shown by the monthly averages in Table I., the ammonia in the common gas manufactured at the Westminster works, during the first three months of testing, averaged 3·2 grains per 100 feet of gas; in the subsequent six months, it was less than 2 grains; in the cannel gas, in the same periods, it was respectively 4·9 and 2·9 grains. At the Brick Lane works, in the first three months of testing, the average amount of ammonia was 6·57 grains; in the subsequent six months it was only 2 grains. At the Curtain Road works, during the first three months, the ammonia averaged 3·7 grains; in the subsequent six months 2·55 grains; and at the Bow works the amount of ammonia, during the same periods, averaged respectively 1·2 and ·29 grains. These statistics show a marked improvement in the purity of the gas, as regards ammonia, subsequent and directly attributable to the passing of the Act of 1868.

The referees have also much pleasure in stating that the Imperial Company is now increasing its scrubbing power both at St. Pancras and at Haggerston; and at the Bow works of the Chartered Company extensive improvements in the scrubbers are likewise in progress.

Ammonia Purification.

The process of purifying gas from ammonia consists mainly in bringing the gas in contact with water, which has a remarkable affinity for ammonia, water

being capable of absorbing fully 700 times its own volume of ammonia; and the most perfect process of ammonia purification is that which does its work with the least amount of water—(1) because, when much water is used, it tends to absorb a portion of the hydrocarbons, which constitute the light-giving element of gas; (2) because the ammoniacal liquor so formed is too weak to be saleable in that condition; and (3) in consequence of this the "liquor" has to be returned into the scrubbers several times to bring it up to the required strength, whereby the impurities with which the water is charged are again brought in contact with the gas.

In many provincial gas-works the ammonia purification is effected by "washers"—an apparatus in which the gas is made to pass or bubble through water; in some other gas-works the process in use may be described as a shower-bath, where the gas passes up through a descending shower of water. Both of these processes are defective in this respect, that the gas is never brought in contact with clean water, the "liquor" being kept in the washers, and returned into the shower-bath apparatus, until it is brought up to the saleable strength—an arrangement which, as already said, is objectionable, inasmuch as the water absorbs, besides ammonia, sulphuretted hydrogen and carbonic acid; and all these impurities, being volatile, are liable to be given back into the gas. It is true that the same system of returning the "liquor" into the apparatus until it acquires a saleable strength, generally prevails also where scrubbers are used; but the difference is that with washers, and in the shower-bath apparatus, this system is indispensable, whereas it may be wholly avoided if a perfect kind of scrubber is used. Moreover, in almost every case where scrubbers are used, the gas is brought in contact with clean water in the last scrubber of the series—thereby cleansing the gas to an extent which is impossible in washers.

A minute division, also, both of the water and of the gas, is of paramount importance in ammonia purification, for the absorbent power is confined to the *surfaces* exposed to its action. Even in scrubbers the minute division of the water is sometimes too little attended to—the water being passed through the apparatus in excessive quantity, in fact in streams; with no improvement as regards ammonia purification, and with disadvantageous results to gas companies as regards economy and convenience. The more finely or minutely the water is divided in the scrubber, and the more equally distributed over the scrubbing material, the more efficient is the process of ammonia purification.

The scrubber consists of a tall iron cylinder, filled with pieces of insoluble material, down between which the water percolates, in such a manner that it is brought gently and at all points in contact with the ascending stream of gas. The material with which the scrubber is filled may be of various kinds. The material most generally used is coke, which is the cheapest (indeed costless, because the coke when "foul"—*i.e.*, thickly coated with tar—can be used in the retorts, or in some works as fuel in the furnaces), and also gives excellent results owing to its porosity. The gas does not indeed pass through the pores of the coke, but the surface of this material being full of small cavities, the water lodges therein, and thereby comes in contact with the gas in a better manner than when brick or stone is used; but as soon as the surface of the coke becomes coated with tar, the peculiar advantage of this material is lost. Another kind of scrubber is one filled with tiers of thin deal boards placed on edge, over the surfaces of which the water drips, and the ascending gas is purified by coming in contact with those wetted surfaces. A scrubber somewhat similar, but less effective, consists of horizontal shelves of wood, so constructed as to keep their upper surface always covered with water to the depth of about a quarter of an inch, the water absorbing ammonia as the gas passes over it.

The apparatus for delivering water to the scrubber is at least as important as the material with which the interior of the scrubber is filled. The best kind of distributing apparatus is one which by minutely dividing the water, and also wetting all parts of the scrubbing material equally, enables the purifying work to be done with the smallest amount of water. As a matter of economy, and also for perfect purification, it is desirable that there should be no pumping of the liquor back into the scrubbers—a process which can be dispensed with if one of the best kinds of scrubber is used.

In order that the scrubbers may be kept in an efficient condition, it is necessary that the gas, before entering them, be properly condensed and cooled. The condensers ought to be of adequate size and efficiency to allow of all the tarry vapour being eliminated from the gas, and drawn off into the tar-well; for, if this be not done, a portion of the tar is carried forward into the scrubbers, and is deposited there instead of in the condensers. The effect of this is doubly disadvantageous—firstly, by choking up the interstices in the coke or brick scrubbers, so that the gas, instead of ascending equally through all parts of those scrubbers, forces a passage upwards by a comparatively few routes, and thereby does not come in a proper manner in contact with the purifying water. The other disadvantage is that the gas, in such cases, encounters an unnecessary amount of resistance in passing through those scrubbers, producing an inconvenient amount of "back pressure," which has to be overcome by the action of the exhausters, and also necessitating more frequent changes of the scrubbing material than would otherwise be required. Not less important is it to observe that, if the gas be not properly cooled in the condensers, the water in the scrubbers is raised above the ordinary temperature, whereby its power of absorbing ammonia is lessened; while at the same time the "liquor," after leaving the scrubbers, gives off into the air a larger portion of the ammonia with which it is charged than it would do at the ordinary temperature.

In gas-works where the size or efficiency of the scrubbers is not adequate for the work required of them, their action is supplemented by the use of sulphate of iron, or of sawdust moistened with sulphuric acid, either used separately, in small purifiers, or introduced on trays in the oxide of iron purifiers employed for the elimination of sulphur. This supplementary process, however, although effective for the removal of ammonia, is (or at least ought to be) only a makeshift, rendered necessary by a want of room for the erection of additional or of larger scrubbers, or else owing to a temporary increase in the make of gas to a greater extent than the scrubbers can cope with; for these supplementary processes yield less profit to the companies than is obtained when the ammonia purification is effected solely by scrubbers.

The separation of ammonia from the gas is a most profitable process for the gas companies, and was adopted by them at first of their own accord, as a means of increasing their revenue. For example, let us suppose that thoroughly efficient scrubbers are used—*e. g.*, such as those at the works at Blackfriars. In those works there are five scrubbers, costing for construction £500 or £600 each, or less than £3000 in all; but the value of the ammoniacal products obtained from these scrubbers is £3000 per annum,* while the cost of labour per annum is virtually nothing, the scrubbers being self-acting, and the coke with which they are filled requiring to be changed (at the cost of about £10 for each scrubber) only once in two or three years. Hence it appears that, with the very best kind of scrubbers, the cost of erection is repaid in a single year, and thereafter a large annual revenue is received from them. In this respect ammonia purification stands in a different category from sulphur purification, the processes of which constitute a pure outlay on the part of the gas companies.

Amount of Ammonia in Gas.

The quantity of ammonia contained in gas varies, to some extent, with the kind of coal used. A small portion of this ammonia is lost to the companies, and cannot be estimated, owing to its being drawn off with the tar from the hydraulic main and condensing-pipes into the tar-well; and, as will be afterwards seen, another portion passes uncaught from the scrubbers, and is either wholly or partially absorbed by the moisture in the oxide of iron purifiers. But, with these trifling deductions, the quantity of ammonia contained in gas is ascertainable from the amount of ammoniacal products obtained by the companies from their purifying apparatus.

Table III. shows the amount of ammoniacal liquor obtained per ton of coal in the different gas-works; and as, at the Blackfriars works, the whole of the ammonia is taken out of the gas, and also is eliminated almost entirely by the scrubbers in the form of ammoniacal liquor, the actual amount of ammonia may be calculated. At these works, 20 gallons of ammoniacal liquor of "10 ounces" strength* are obtained from each ton of coal—showing that the gas from each ton of coal contains about 1-10th of a per cent. of ammonia gas (NH_3)—in other words, one foot of NH_3 in every 1000 feet of gas.

A considerable proportion of the ammonia is eliminated from the gas in the condensing-pipes, before reaching the scrubbers; and the more efficient the condensing process, the more easily is the work of ammonia purification carried on in the scrubbers. At the Blackfriars works the condensers yield per ton of coal about 9 gallons of 6-ounce liquor, and the scrubbers yield 11 gallons of 14-ounce strength; so that, in this case, one-third of the ammonia is taken out by the condensers and two-thirds by the scrubbers. But the ammonical liquor obtained from the condensers is too weak to be saleable; hence it has to be mixed with the stronger liquor obtained from the scrubbers. The requisite commercial strength of the "liquor" is about 10 ounces; if the liquor is much below that strength, it is objectionable from its bulk, and if it is much above that strength it is likewise objectionable as a saleable commodity, owing to its tendency to lose a portion of its ammonia by volatilization.

The "liquor" obtained from the condensers varies in strength from about 4½ to 7 ounces—these variations being mainly due to the condition of the coal as delivered to the retorts; for the drier the coal, the less aqueous vapour is contained in the gas, and accordingly the ammoniacal liquor formed in the condensers is less diluted than when the coal is more or less damp.

The ammonia which remains in the gas after passing through the scrubbers at the Blackfriars works only amounts to 2 or 3 grains per 100 feet of gas. This residue is entirely eliminated from the gas by absorption in the moisture contained in the oxide of iron purifiers employed for the elimination of sulphur; but in this way it is lost to the companies. At the same time it is to be observed that, in proportion as the amount of ammonia in the gas is reduced, the difficulty of catching it in the scrubbers becomes immensely increased. For example, in the excellent scrubbers employed at the Blackfriars works, where the coke is divided into three tiers or compartments, each 8 feet in depth, it is found that the lowest tier, which the gas first enters, yields *of itself* 11½-ounce liquor; the middle tier, 2-ounce liquor; and the uppermost tier, only ½-ounce liquor. In other words, of the total amount of ammonia eliminated by this scrubber (which yields 14-ounce liquor), the uppermost tier takes out only 3½ per cent., while the undermost takes out 82 per cent. Arguing from such facts, it is a common opinion in gas-works that the more the water is impregnated with ammonia, the more capable is it of absorbing ammonia—a notion, it is hardly necessary to say, wholly erroneous. The explanation of the fact which has given rise to this notion is evidently the very simple one, that the difficulty of catching ammonia (or any other substance) is immensely increased when the ammonia is greatly diluted, or, in other words, exists only in an infinitesimal quantity, compared with the volume of gas in which it is contained; whereas, when the water or "liquor" comes in contact with the unpurified gas, as it does in the lower part of the scrubber, the proportion of ammonia absorbed is very large.

Apparatus for Ammonia Purification in the several Gas-Works.

Table III. shows the extent and character of the apparatus employed for the purification of gas from ammonia—including, for the reasons above stated, the condensing surface—in each manufacturing station of the companies placed under the supervision of the referees by the Gas Acts of 1868 and 1869.

In connexion with this table we append the following remarks:—

I.—*Condensing Surface.*

The condensing surface, as given in the table, includes not merely the superficial area of the condensers proper, but also of the whole length of pipes between the hydraulic main (which receives the gas directly from the retorts) and the scrubbers. We adopt this mode of statement because in some works there are no condensers proper—as at Beckton, where the condensing work is at present effected simply by a long range of pipes—and also because every yard of pipe between the retorts and the scrubbers exerts some power of condensing the gas.

The *extent* of the condensing surface, however, is no criterion of the actual degree to which the gas is cooled and cleansed from tar. The condensing power depends, of course, upon the degree to which the pipes are exposed to cooling influences; and the pipes may be either placed in water, or with water dripping upon them, or filled with coke (*i.e.*, dry scrubbers), or simply exposed to the air, or, lastly (as at Beckton), kept mainly underground. It is disadvantageous to subject gas to a *sudden* cooling (one effect of which is to produce a deposit of naphthaline, choking up the subsequent pipes, and also withdrawing from the gas a portion of its light-giving elements); hence it is desirable that the condensing should be effected gradually, and as far as possible under uniform influences.

One of the most certain means of keeping the condensing action at a steady point is by placing the condensing-pipes underground, where the temperature is more uniform than if the pipes were in air, exposed to the great vicissitudes not only of summer and winter, but also to the daily differences of temperature produced in the pipes by sunshine and cloud, and most of all by a summer shower, which by rapid evaporation produces an exceptionally great and sudden cooling of gas. At the same time, as radiation proceeds very slowly in underground pipes, the surrounding soil retaining a large portion of the heat imparted to it by the gas in the pipes, the underground process of condensing requires an exceptionally large extent of pipe in order to be adequately effective. On the other hand, the underground process avoids the difficulty experienced in condensers proper, on hot sunny days, when the effect of the sunshine upon these open-air pipes may considerably *raise* the temperature of the gas, thereby nullifying to some extent the cooling already effected. This process also attains, to a greater degree than any other, the important object of keeping the tar for a long time in contact with the gas, whereby as large as possible a portion of the hydrocarbons (the light-giving elements) are retained in the gas, instead of being partly drawn off with the tar.

Another means of efficient condensing at a steady temperature is the process of placing the condensing-pipes in a tank of water, arranged in channels, with the water flowing in an opposite direction to the gas in the pipes, the cool entering water coming in contact with the gas-pipes only at their outlet from the tank, and becoming gradually warmed in the subsequent channels in proportion as it reaches the other end of the tank, where the gas enters at a high temperature (about 120° Fahr.) from the pipes in the retort-house. This process is employed at the works of the South Metropolitan Company (in the Old Kent Road), and the engineer, Mr. Livesey, states that he finds no difficulty in maintaining the water in the tank at a nearly uniform temperature, both in summer and winter. The temperature of the water is duly examined at intervals, and it is kept at a steady point by simply increasing or diminishing the admission of water, according as it is desired to lower or raise the temperature of the tank.

This process has the advantage not only of affording means for neutralizing the great variations in the external temperature, but also of adequately meeting the variations in the make of gas, simply by regulating the flow of water through the tank. The South Metropolitan Company have special facilities for the employment of this condensing process, for they have a right to the free use of the

* The coal carbonized at the Blackfriars works in 1870 was 63,404 tons, each ton yielding 20 gallons of ammoniacal liquor of 10 ounces strength—the present selling price of the liquor being 5s. 2d. per butt of 108 gallons.

* "Ten-ounce liquor" means ammoniacal liquor of such a strength that 10 ounces of sulphuric acid, sp. gr. 1·845, are required to neutralize a gallon of it.

water in the adjoining canal. Nevertheless, the referees are of opinion that there is no obstacle to the adoption of the same process by any gas company. The only possible obstacle would be the cost of the water; but in every gas-work the quantity of water in daily use is amply sufficient of itself to supply the condensing tank, if the water, or a portion of it, were delivered into the tank in the first place, and thereafter used for the ordinary purposes in the works.

At the Fulham works of the Imperial Company, the engineer, Mr. Kirkham, relies mainly for condensing upon "dry scrubbers"—vessels of the same shape and size as ordinary scrubbers, and filled with coke, but with no water passing through them. This kind of condensing apparatus has some special and important advantages. It allows of a more ready *settling* of the tar, and it also tends to separate the tar from the gas by friction, through contact with solid material. On entering one of those "dry scrubbers"—the intersticial area of which, when the coke is unfouled, is much larger than the area of the entering-pipes—the velocity of the gas is greatly reduced; and, in consequence, the tar, which is suspended in the gas, tends to settle—very much in the same way as the mud which is easily carried on by a rapid stream is deposited on entering a pool. But this process of deposition is increased, in these "dry scrubbers," by the gas coming at all points in contact with surfaces which promote such a deposit—the tar, in fact, is as it were "combed out" of the gas by having to pass through the network of coke with which this condensing apparatus is filled.

Although the *extent* of the condensing surface is no criterion of the effectiveness of the process, it nearly corresponds with the *cost* of the apparatus; and accordingly it is desirable to give it, leaving the companies to determine whether the results obtained in their works are the best which can be obtained at the same cost.

TABLE III.

Manufacturing Station.	Chartered Company.						Imperial Company.			South Metropolitan Company.
	Beckton.	Westminster.	Brick Lane.	Curtain Road	Blackfriars.	Bow Common.	Fulham.	St. Pancras.	Haggerston.	
Total Condensing Surface .	32,342 sq. ft.	14,855 sq. ft.	7744 sq. ft.	1,957 sq. ft.	13,470 sq. ft.	10,364 sq. ft.	16,761 sq. ft., including 7 dry scrubbers.	26,258 sq. ft.	13,564 sq. ft.	14,666 sq. ft.
Number of Scrubbers . . .	10, but only 9 at present in action.	6	3	2	5	4	4	2	2	4
Height and Diameter. . .	30 × 20	2. 20 ft. high by 16 1. 21 × 14 1. 20 × 15 1. 16 × 11 1. 15 × 10	2. 34 × 12 1. 20 × 12	1. 30 × 10 1. 18 × 7	30 × 12	27 × 10	2. 20 × 12 2. 20 × 6	1. 22½ × 20 1. 15 × 12	1. 40 × 20 1. 20 × 20*	28½ × 15½
Scrubbing Material and its Arrangement . . .	Coke in 2 layers, with open space between.	Coke in continuous mass.	In 34 × 12, 3 layers 8 ft. high and open spaces between In 20 × 12, coke in continuous mass.	In 30 × 10, 3 layers 8 ft. deep In 18 × 7, coke in continuous mass.	Coke in 3 layers with open spaces between.	1, wood, ½-in. boards, 7 in. deep, and ½ in. apart. 3, brick in continuous mass.	2, coke in continuous mass. 2, wood shelves.	Coke, continuous mass.	1, wood, ½-in. boards, 9 in. deep × ½ in. apart. 1, coke in continuous mass.	½-in. boards, 11 in. deep, and from 1 to ½ in. apart, arranged in tiers.
Depth of Material in each Scrubber	18 feet.	15·5 ft. 16·5 ,, 15·5 ,, 11·5 ,, 10·5 ,,	In 34 × 12, 24 ft. of coke. In 20 × 12, 15 feet.	In 30 × 10, 24 ft. In 18 × 7, 13 ft.	24 feet.	In 1, 30 tiers, ½ in. between each tier, and 18 in. space half way up. In 3, 20 ft. in each.	16 ft. in each.	1. 16 ft. 1. 10 ft.	1. 34 tiers, each tier 9 ins. deep. 1. 18 ft. coke.	From 21 to 24 tiers in each scrubber, each tier 11 in. deep.
Cubical Volume of Wet Scrubbers	84,823 c. ft. for the 9 scrubbers in action.	17,508 c. ft.	9,932 c. ft.	3,048 c. ft.	16,964 c. ft.	8,482 c. ft.	5,655 c. ft.	8,765 c. ft.	18,349 cubic ft.	21,511 cubic ft.
Quantity of Water or Liquor used per 1000 Feet of Gas cleaned	1 gallon.	1 gallon.	1 gallon.	1 gallon.	1 gallon.	1 gallon, *plus* ammoniacal liquor from condensers in Nos. 1 and 2.	1 gall. ammoniacal liquor, ·3 gallons clean water.	No record kept.	No record kept.	From ·5 to ·75 of a gallon.
Quantity of Gas cleaned per Hour.	Make 125,000 ft.	Max. 200,000. Min. 40,000.	Max. 95,000. Min. 25,000.	Make always about 19,000 per hour.	Max. 125,000 ft.	Max. 120,000. Min. 40,000.	Max. 350,000. Min. 75,000.	Max. 230,000. Min. 40,000.	Max. 250,000. Min. 40,000.	Max. 130,000. Min. 33,000.
Liquid used	Ammoniacal liquor, and clean water in last scrubber.	Water and ammoniacal liquor.	Clean water.	Water.	Clean water.	Ammoniacal liquor in first three. Clean water in the last scrubber.	Ammoniacal liquor and clean water.	Ammoniacal liquor.	Water and ammoniacal liquor.	Clean water in the last scrubber and sometimes in last two. Ammoniacal liquor in others.
Ammoniacal Liquor obtained per Ton of Coal.	Not yet known.	From 15 to 20 gallons 8 oz.	About 10 gallons.	About 10 gallons.	20 gallons of 10 oz. strength.	18 gallons of 10 oz. strength.	14 gallons of 10 oz. strength.	No record kept.	No record kept.	18 gallons of 10 oz. strength.
Back Pressure	From 1 to 3 in.	From ¾ in. to 5 or 6 ins.	1 inch with max. make.	1 inch with max. make.	About 1½ in.	From 1 to 4 in.	From 1 to 3 in.	1 to 2 in., according to make.	1 to 2 in., according to make.	None.
How often is each Scrubber cleaned out? . . .	No change as yet.	When back-pressure rises to 5 or 6 in.	Once in two years.	Once in two years.	Once in three years.	When back pressure rises to 4 in.	Once a year.	Once in 2 years.	No return.	The first erected scrubber has been in use 5 years, and is still perfectly clean.
Supplementary Processes of Ammonia Purification	None.	Sulphate of iron, 6,236 sq. ft. 6 in. deep.	Sulphate of iron, 2,444 sq. ft. 6 in. deep.	None.	None.	None.	Sulphuric acid and sawdust 1,280 sq. ft. from 7 to 18 in. deep.	Sulphate of iron, 7081 sq. feet, 8 or 9 in. deep.	Sulphate of iron, 4,080 sq. feet, 6 in. deep.	None.

* The 20 × 20 coke scrubber at Haggerston has just been doubled in height, and fitted with boards the same as the other scrubber. Accordingly the cubical volume of the scrubbers at these works is now 25,000 feet; in other words, it is increased 30 per cent.

The condensing surface at the several gas-works, per 1000 feet of gas, reckoned upon the average hourly make, is as follows, in square feet:—

Beckton.	Westminster.	Brick Lane.	Curtain Road.	Blackfriars.	Bow.	Fulham.	St. Pancras.	Haggerston.	Old Kent Rd
258 sq. ft.	123·8 sq. ft.	129 sq. ft.	103 sq. ft.	188 sq. ft.	129·5 sq. ft.	79 sq. ft.	194 sq. ft.	93·5 sq. ft.	179 sq. ft.

II.—*The Scrubbers.*

The size of the scrubbers is almost as imperfect a criterion of efficiency as is the volume of the condensing surface. In Table III. we have given the depth of scrubbing material in each scrubber, from which the total amount of this material in the scrubbers used at some of the gas-works may be ascertained by simple calculation. But, in comparing one kind of scrubber with another, to determine their efficiency, the real points to be regarded are the size and cost of the scrubber; and the cost of all the ordinary kinds of scrubbers (*i.e.*, those filled with coke or brick) corresponds very nearly with their size, so that their size or cubical volume, taken in connexion with the results produced, is the true criterion of their efficiency as purifying apparatus. The scrubber filled with thin deal boards costs about a third more than the coke or brick scrubbers—and, as shown in Table III., this kind of scrubber is employed at the South Metropolitan works, and partially at the Bow and Haggerston works of the Chartered and Imperial Companies.

The cubical volume of the wet scrubbers (including the space occupied by the apparatus for distributing the water) at the several gas-works, per 1000 feet of gas, reckoned upon the average hourly make, is as follows:—

Beckton.	Westminster.	Brick Lane.	Curtain Road.	Blackfriars.	Bow.	Fulham.	St. Pancras.	Haggerston.	Old Kent Rd
678·5 cub. ft.	145·9 cub. ft.	165·5 cub. ft.	160·4 cub. ft.	212 cub. ft.	106 cub. ft.	26·6 cub. ft.	64·9 cub. ft.	130 cub. ft.	264 cub. ft.

III.—*Supplementary Appliances.*

The supplementary processes of ammonia purification—viz., by the use of sulphate of iron, or sulphuric acid and sawdust—are, generally speaking, largest in those works where the scrubbing power is least. They were employed at the works of the Chartered Company at Brick Lane (now closed), and are at present employed at the Westminster works of that company, and at all the works of the Imperial Company. At those works the volume of this purifying material, for each 1000 feet of gas, reckoned upon the average hourly make, has been as follows, in cubic feet:—

Per 1000 Feet of Gas.	Brick Lane.	Westminster.	Fulham.	St. Pancras.	Haggerston.
Sulphate of iron . .	20·3 cub. ft.	26 cub. ft.	None.	37·2 cub. ft.	14 cub. ft.
Sulphuric acid and Sawdust . .	None.	None.	6·04 cub. ft.	None.	None.

IV.—*Summary.*

The subjoined table gives a comparative view of the extent of the processes of ammonia purification (including condensing surface) at the several gas-works per 1000 feet of gas, together with the results as shown by the average amount of ammonia in the gas made at those works. As the ammonia purification is

most perfect at the Blackfriars works (the gas supplied from those works being totally free from ammonia), they are here taken as the unit of comparison:—

	Condensing surface.	Area of Scrubbers.	Supplementary Processes per 1000 Feet of Gas.	Ammonia in the Gas per 100 Feet.	
Blackfriars. . .	1·0	1·0	None.	None.	Average Jan. to July, 1870.
Westminster . .	·76	·69	26 cubic ft. sulph. iron	3·02	
Brick Lane. . .	·79	·78	20·3 „ „	2·05	
Curtain Road. .	·63	·75	None.	2·2	
Bow	·80	·5	None.	·44	
Beckton	1·53	3·2	None.	None.	
Fulham	·48	·12	6·04 c. ft. sul. acid, &c.	·48	Average Sept. 1870 to March, 1871.
St. Pancras. . .	1·2	·5	37·2 cub. ft. sulph. iron.	1·8	
Haggerston. . .	·57	·61	14·0 „ „	1·4	
Old Kent Road .	1·1	1·24	None.	·82	

The referees believe that the above-given statistics of ammonia purification are not only interesting upon public grounds, but will possess a highly practical interest for the gas companies and their engineers; indeed, one great advantage from the establishment of a board like that of the referees is, that, having full powers to inspect the various gas-works, they are in a position to do what has never been done before—namely, to examine minutely every stage in the work of purification, comparing one gas-work with another, thereby correctly ascertaining the highest degree of purity which can practically be attained in gas as supplied to the public, and also furnishing each gas company with valuable (and hitherto unattainable) information of what is being done in the works of other companies, and thereby, either voluntarily on the part of the companies, or by direct injunctions, ensuring as promptly as possible the adoption of the best apparatus and processes of purification in the gas-works under their supervision.

To complete these statistics of ammonia purification, the referees are making a series of experiments upon the amount of ammonia in the gas, both at the inlet and outlet of the several scrubbers in each gas-work under their supervision, in order that the efficiency of each kind of scrubber may be fully and practically demonstrated. They have already made a series of eight or ten testings of this kind at each of the five principal gas-works in London; but in order to obtain reliable results, they consider that the experiments must be continued at intervals over several months, because in some cases the scrubbers had been newly fitted up, or filled with fresh scrubbing material, while in others the scrubbers were comparatively old. The season of the year and the make of gas have likewise to be taken into account. When the experiments are completed, the results will be duly reported to the Board of Trade, by which time also the working of the reduction in the maximum for the ammonia impurity will be ascertained.

Remarks upon the Construction of Scrubbers.

If all scrubbers were identical in construction, the results of purification would correspond with the size of the scrubbers. But, as the records of the official testings show, such is not the case, even the cubical volume of the scrubbing material being an inadequate criterion of the purifying power; and the cause of the difference is to be found in the different character of the scrubbers in use at the several gas-works.

The points of difference may be summarized thus:—1, the kind of material with which the scrubbers are filled; 2, the arrangement of that material; 3, the quantity of water passed through the scrubbers; 4, the manner in which the water is distributed; and, 5, whether or not the ammoniacal liquor is returned into the scrubbers.

Firstly, as to the scrubbing material and its arrangement:—

1. The ordinary scrubber, in which the interior of the apparatus is filled with coke or brick in a continuous mass from top to bottom. 2. The scrubber (like Mr. Mann's) where the coke is arranged in several tiers or compartments with an open space between each, where the gas distributes itself anew through the purifying material. 3. The Livesey scrubber, where thin deal boards are used, set on edge and arranged in several tiers, the boards of each tier being set so as to slightly cross those of the tier immediately above and below it. 4. Where wooden shelves covered with water are used, as in two of the scrubbers at the Fulham works.

Secondly, as to the water supply to the scrubber:—

The apparatus generally employed for the distribution of water in scrubbers consists of several tubes radiating from the centre to the circumference, and pierced with holes from which the water is distributed in jets upon the mass of coke or other scrubbing material beneath, the holes usually increasing in number as they approach the circumference, where a larger area of material has to be wetted. In order to minimize the supply of water, Mr. Mann uses three tubes open only at the ends, from which the water trickles in a very fine stream, each tube revolving on a fixed centre.

Whether the distributing-tubes are fixed or revolving, the water from the holes or jets necessarily falls always upon certain spots, the other parts of the surface of scrubbing material remaining comparatively unwetted, although, doubtless, the water soon distributes itself more equally as it descends through the scrubber. To remedy this defect, and to perfect the water distribution, Mr. Mann interposes between the distributing tubes and the underlying coke a "birch-wheel," or revolving thick layer of birchwood twigs, lessening in depth towards the circumference, through which the water trickles slowly and equally at all points. The uppermost part of Mr. Mann's scrubber, also, containing the apparatus for water distribution, is made a few inches wider than the rest, in order to secure that the *sides* of the scrubber are well wetted, as the gas usually ascends more freely by the sides than up through the interior mass of scrubbing material.

When new scrubbers are erected, or when old ones are remodelled, the form now being adopted is either that of the Mann or of the Livesey scrubber.

The *Livesey Scrubber*, used by the South Metropolitan Company (at the Old Kent Road), was devised mainly in order to avoid the choking or fouling which occurs with coke or brick scrubbers by tar, which creates an inconvenient amount of "back pressure," and also necessitates a change of the scrubbing material. Judged from this point of view, the Livesey scrubber has been a success; for it gives no back pressure (in other words, the gas encounters no resistance at all in passing through it), and apparently it will last for an almost indefinite time without any change of the material with which it is filled. It is found that the deal boards, though constantly wet, show no tendency to rot, a result doubtless due to the antiseptic influence of the tar in the gas. The open area or intersticial spaces in this scrubber, as used at the Old Kent Road (where the boards are set on the average about $\frac{3}{4}$ inch apart) are on the average three times greater than the area of the pipes which lead into and out of it; and as these spaces are not liable to be choked up, it follows that the gas can encounter no resistance in passing through, so that no back pressure is produced. The weak point of this scrubber is that it cannot eliminate the tarry vapour from the gas so well as the coke scrubber; accordingly, where this kind of scrubber is used, the previous work of condensing the gas ought to be very carefully attended to.

In some works the boards are set closer than in the scrubber used by Mr. Livesey himself, and doubtless this is an advantage as regards purifying power; but it cannot yet be determined whether this advantage may not be counterbalanced by the greater tendency to foul, thereby producing back pressure, and also necessitating a more frequent change of the scrubbing-boards, which in this scrubber is an expensive process.

A scrubber of this kind, we believe, was first adopted at the Haggerston works of the Imperial Company, where another scrubber is being erected of a similar kind, fitted with the excellent apparatus for water distribution employed by Mr. Mann.

The *Mann Scrubber*, however, at present holds the first rank as regards efficiency, and perhaps also economy. Its first cost is considerably less than that of the Livesey scrubber; and although its contents require to be changed more frequently than those of the Livesey scrubber, yet as its coke has to be changed only once in three years, and as the cost of this is very trifling compared with that of renewing the woodwork in the Livesey scrubber, the cost of construction and maintenance may be stated on the whole as in favour of the Mann scrubber. The special advantage of the Livesey scrubber, as already said, is, that it gives no back pressure, thereby lightening the work of the exhausters, which is equivalent to a saving of fuel. On the other hand, Mr. Mann's scrubber, taken in connexion with his condensing apparatus, at present gives the best results of any as a purifier, and is also the most simple and economical in its action, seeing that no pumping of the liquor back into it is required.

The strength of the ammoniacal liquor obtained from this scrubber is much greater than that from any other. In nearly all gas-works the liquor has to be passed several times through the scrubber before it acquires the requisite commercial strength of "10 ounces;" whereas the Mann scrubber yields fully "14-ounce" liquor, so that it can be mixed with the weaker (5 or 6 ounce) liquor obtained from the condensers, and yet remain fully up to the strength required of it as a saleable commodity, and this by being passed merely once through a single scrubber. The usual practice is to pass the whole of the gas through all the scrubbers in succession, each scrubber, of course, yielding a different strength of ammoniacal liquor according to its position in the series; whereas Mr. Mann distributes the gas in equal quantities into each scrubber separately, and each scrubber of itself completes the work of purification, yielding liquor of the same strength.

It may be added that Mr. Mann is at present endeavouring to perfect a self-acting process of water distribution, by using an apparatus on the principle of the Barker's mill, but with a means for preventing the choking up of the holes—a difficulty which has hitherto rendered this simple process very troublesome when applied to scrubbers. If this new arrangement prove successful, and be used in connexion with the Mann scrubber, it will be especially adapted for use in small gas-works, neither engines nor pumps being required, seeing that the water apparatus is self-acting, and also that the "liquor" has not to be pumped back into this kind of scrubber. But, as regards this new mode of water supply, as it has not yet been adequately tested, the referees cannot at present pronounce an opinion upon its durability in an efficient condition.

Mr. Mann's scrubber, as already stated, takes the whole of the ammonia out of the gas, save a trace, which is removed by simple absorption by the moisture in the oxide of iron purifiers; so that the gas as supplied to the public is entirely free from this impurity. As it has been thought in some quarters that this scrubber attains its excellent results at the expense of the illuminating power of the gas, the referees made several experiments on different days to determine this point. For this purpose they employed two jet photometers which they had previously ascertained to give exactly similar indications of the illuminating power; and as the result of several testings, they found that the gas as it left the scrubber gave an illuminating power almost identical with that of the gas as it entered; in other words, there was no appreciable loss of illuminating power at all from the action of these scrubbers.

The result of these testings is worthy of general notice, because many gas engineers hold that all contact with water reduces the illuminating power of gas, whereas no such injurious effect is produced except where water is employed in excess; that is to say, in much greater quantity than is needed, or indeed than is economically advantageous even as regards the ammoniacal products obtained from the scrubbers.

General Remarks and Suggestions on Ammonia Purification.

An adequate condensation of the gas (apart from its advantage as regards the manufacture of gas generally) is, as we have shown, a matter of importance as regards ammonia purification; for, if the gas is not properly cooled before entering the scrubbers, the absorbent power of the water in these vessels is diminished; and if tarry vapour in large quantity is carried forward into the scrubbers, the scrubbing material (as sometimes happens) may be suddenly "fouled" to a degree which seriously affects the purifying action of the apparatus.

Underground pipes are very defective as condensers, but, as already said, they serve to keep the tar for a longer time than usual in contact with the gas. This object, so far as is at present known, appears to be sufficiently important to render it worthy of attention in all gas-works, by devoting a considerable length of pipes (placed either underground or along the inner side of the walls of the retort-house) to this purpose. Thereafter the work of condensation proper may be carried on quickly and safely.

The referees consider that the best means of condensation is to be found in the "dry scrubbers" of Mr. Kirkham, and the water-tank process used by Mr. Livesey. The latter process is capable of securing the condensation of the gas in little space and at a steady temperature, whatever be the variations in the external temperature or in the make of gas; and the former, the "dry scrubbers," afford an unequalled means of facilitating the elimination of tar by *settling*, and also by bringing the tarry vapour into contact with surfaces which promote its deposit. A combination of these two processes would accomplish the work of condensation in a manner which would leave nothing to be desired.

The ordinary system of condensing the gas in pipes of uniform and small size is certainly defective; for, although the *cooling* of the gas may be adequately effected in such pipes, they offer no facility for the mechanical settling or deposit of the tar. Accordingly, the referees consider that, whatever be the method employed for cooling the gas, large chambers ought to be introduced in the condensing-pipes, wherein the velocity of the gas stream is reduced, so that the tar may settle down, instead of being carried on, mechanically suspended, in the rapid current; and if those chambers can conveniently be filled with coke or other substance promoting a deposit of the tar on its surfaces (as in Mr. Kirkham's "dry scrubbers") the condensing process will be still more efficient.

In the majority of gas-works, the work of condensation is at present carried on by pipes or vessels in the open air; and it appears to the referees that means might be adopted to lessen the untoward effects of the great vicissitudes of temperature to which such open-air condensers are exposed. The effect of these vicissitudes upon the temperature of the gas is very powerful. For example, after a summer shower, following hot sunshine, a gasholder of ordinary size will fall to the extent of 6 feet, and it will rise to an almost equal extent when a cloudy morning suddenly gives place to brilliant sunshine; from which facts it appears that these vicissitudes at times raise or lower the temperature of the gas to the extent of about 30 degrees. The same influences, of course, operate upon all the open-air pipes and purifying apparatus in gas-works. Indeed, the referees have observed that even in the scrubbers a sunny day occasionally raises the gas several degrees above the temperature at which it enters them, thereby diminishing the purifying power of the apparatus. They, therefore, suggest that it would be advantageous to protect the condensers, and indeed the scrubbers also, by a covering of some kind,* which, however slight, would greatly neutralize the vicissitudes of temperature which are so striking a characteristic of our climate, and thereby allow of the operations being carried on at a steady temperature, such as the engineers in the several works may find most suitable to the efficiency of their apparatus.

Some of the scrubbers at present in use in the London gas-works might be considerably improved as purifying apparatus by the adoption of a more perfect

* Such protection is afforded to some extent where Mr. Mann's "birch-wheel" is used, which covers the top of the scrubber.

mode of water distribution. The referees also consider that in every coke or brick scrubber the material ought to be arranged not in a continuous mass, as is usually the case, but in separate tiers, varying in number with the height of the scrubber—each tier being about 8 feet in depth, with an open space not less than half a foot in depth between each tier—and also with a moveable plate at each open space, by the removal of which the action of the water distribution and the general condition of the scrubber can from time to time be observed. The advantages of such an arrangement are—(1) that in these open spaces the ascending gas redistributes itself, instead of forcing a passage upwards through a few routes from bottom to top, as it always tends to do in proportion as the scrubber becomes foul with tar; and (2) by observing the drip of the water in those open spaces, the efficiency of the water distribution could be ascertained at the outset, and the general condition of the scrubber inspected at all times, instead of remaining unknown and inscrutable, as is the case in ordinary scrubbers, the condition of which is only judged of at present by the amount of "back pressure" which they give, which is a most inadequate criterion of the condition of the scrubber.

As already stated, the referees regard it as economically advantageous that in all gas-works the ammonia should be removed wholly by means of scrubbers, not only because this would save labour (required for changing the trays of sulphate of iron and the sulphuric acid purifiers), but also because the ammonia yields a better return in the form of ammoniacal liquor, as obtained from the scrubbers, than when the above-described "supplementary" processes of ammonia purification are employed. The full details which the companies possess of their receipts and expenditure will doubtless convince them that it is advantageous to do the work of ammonia purification wholly by means of scrubbers.

Conclusion.

The process of purifying gas from ammonia (unlike sulphur purification) is simple and thoroughly understood; and in Mr. Mann's scrubber we have an apparatus which does the work perfectly, entirely freeing the gas as supplied to the public from this impurity. Hence it may seem that the referees are entitled at once to require that the gas of the companies under their supervision (those included under the Acts of 1868-9) should be supplied to the public wholly free of ammonia. But the referees are bound to take into account existing circumstances; and they cannot disregard the fact that the scrubbers in most of the gas-works must either be greatly altered or greatly enlarged before the desired object of entirely ridding the gas from ammonia can be attained. The Acts of 1868 and 1869 require that the companies shall be allowed a suitable length of time to make the alterations in their works which may be necessary to enable them to meet the requirements of the referees. Moreover, the reduction or total prohibition of the gas impurities is a result to be accomplished for the interests of the public; and it is the duty of the referees to take care that they do not benefit the public in this respect by damaging those interests to a greater extent in another. The referees desire to avoid imposing suddenly upon the gas companies, for the sake of improved purification, an outlay for new works or apparatus which would injuriously affect the interests of the public as regards the price of gas, thereby preventing or retarding the reduction of price which ought to be a necessary consequence of the amalgamations of companies now in progress, as well as of the enlarged manufacture due to the gradual increase in the consumption of gas in the metropolis and suburbs.

The order of the referees, by which the maximum allowed for the ammonia impurity is to be reduced one-half after the 30th of September, is fully in accordance with the above remarks; for it gives the companies ample time to make the requisite changes in their apparatus for ammonia purification, and imposes upon them no outlay but such as they are imperatively called upon to undertake in the interests of the public. The referees have given six months notice to the companies of their intentions in regard to the ammonia maximum, and it is hoped and believed that, thus duly warned, the companies will make their arrangements accordingly. Indeed at the St. Pancras and Haggerston works of the Imperial Company, and also at the Bow works of the Chartered Company, the scrubbing power is now in progress of being largely increased. With the fact before them that the Mann scrubber entirely purifies the gas from ammonia, the referees cannot permanently allow of any inferior result of purification in any of the gas-works under their supervision. The statements given in this report tend to show that, notwithstanding the outlay in making the change, it will be of ultimate advantage to the companies themselves to adopt the Mann scrubber, or some equally efficient apparatus, by which the whole of the ammonia is taken out of the gas. But, whether this be so or not, it is indispensable, in the interests of the public, that the best processes of purification should be everywhere adopted; and, with due time allowed to the companies, the referees have resolved that what has been done at the Blackfriars works shall be done in every gas-work under their control, and that, so far as regards the companies included under the Acts of 1868 and 1869, gas shall ere long be supplied to the public practically free from the ammonia impurity.

T. Foster, Secretary.

Dr. Whitmore's Report on the Quality of the Water supplied in St. Marylebone, in July, 1871:—

July, 1871.	Total Solid Matter in degrees or grains per Imperial gallon.		Loss by Incineration of Solid Matter in previous column.		Ammonia.
	July, 1870.	July, 1871.	July, 1870.	July, 1871.	
Distilled Water	0°	0°	0°	0°	0°
West Middlesex water	16·24	16·94	0·60	0·78	—
Grand Junction water	16·57	17·41	0·62	0·78	—

* The loss by incineration represents the amount of organic and other volatile matters contained in an Imperial gallon (70,000 grains) of water.

Dr. Whitmore's Report on the Quality of the Gas supplied in St. Marylebone, in July, 1871:—

July, 1871.	Illuminating Power in Sperm Candles.			Mean Pressure in Tenths of an Inch.		Mean Quantity of Sulphur in 100 Cub. Ft.	Mean Quantity of Ammonia in 100 Cub. Ft.	Sulphuretted Hydrogen.
	*Mean of 24 Obser.	Highest.	Lowest.	Highest.	Lowest.	Grains.	Grains.	
Imperial Company's gas	17·10	17·71	16·56	27·32	10·72	32·02	1·72	None.
Chartered Company's common gas	16·94	17·44	16·03	41·23	16·75	33·55	1·37	None.
Chartered Company's cannel gas	23·99	24·77	22·41	34·51	13·82	27·83	0·98	None.

Mean of daily readings of barometer . . . 29·74
" " " thermometer . . . 70·78

* Each observation consists of 10 readings of the photometer, at intervals of one minute.

The mean illuminating power of the Imperial gas was very high during the month, being upwards of 17 candles. It ranged from 17·71 to 16·56 candles. The mean quantity of sulphur in 100 cubic feet of gas was 32 grains, and of ammonia 1·72 grains. The mean light of the Chartered Company's common gas was also very high; it amounted to 17 candles, and ranged from 17·44 to 16·03 candles. The mean quantity of sulphur was 35½ grains, and of ammonia 1·37 grains. The cannel gas gave a mean light equal to 24 candles, and ranged from 24·77 to 22·41 candles. The quantity of sulphur found was 27·83 grains and of ammonia less than one grain. On no occasion was sulphuretted hydrogen detected in either of the gases. The pressure of all was satisfactory. These results are obtained from the gas manufactured by the Imperial company, at their Fulham works, and from the Chartered Company's gas manufactured at their works, Horseferry Road, Westminster.

Dr. Stevenson's Report on the Illuminating Power of the Gas supplied in St. Pancras, in May, June, and July, 1871.—During the month of May the average illuminating power of the gas was 15·1 standard candles; the maximum being 16, and minimum 14 candles. On no occasion of examination did the illuminating power of the gas fall below the legal standard of 14 candles, whilst the average was 1·1 candle above this. Ammonia was invariably present in small quantities. Sulphuretted hydrogen was never present. Sulphur was present to the amount of 21·17 grains per 100 cubic feet. This is about the usual amount. The statute fixes no permissible maximum for this impurity.—During the month of June the average illuminating power of the gas was 14·6 standard sperm candles; the maximum being 15·6, and the minimum 14·0 candles. On no occasion did the illuminating power of the gas fall below the legal standard of 14 candles, and the average was ·6 candle in excess of the prescribed minimum. Ammonia was invariably present in small quantities on each occasion of examination. Sulphuretted hydrogen was never present. Sulphur was present to the extent of 17·93 grains per 100 cubic feet. This is somewhat below the customary amount of this impurity, for which no statutory maximum is fixed.—During the month of July the average illuminating power of the gas was 14·6 candles; the maximum being 14·9 candles, and the minimum 13·7 standard sperm candles. An illuminating power of 14 candles is prescribed as a minimum by the statute. The average illuminating power was nearly exactly the same as during the preceding month, but the determinations showed during July a more uniform quality than during June. Of impurities, ammonia was invariably present, though never in excessive amount; sulphuretted hydrogen was never present. Sulphur was present to the extent of 17·97 grains, being a decrease of about 1½ grain when compared with the quantity in June.

Workmen's Treat—Cambridge Gas and Water Companies.—The *employés* of these companies united to make a steamboat excursion to Ely, on Wednesday, the 9th inst. On their arrival at the ancient city, the party, about 80 in number, proceeded to view the cathedral and to enjoy the beautiful prospect of the surrounding country from the roof. At one o'clock dinner was provided at the Corn Exchange—Mr. W. Wood, the manager of the gas-works, presiding. Mr. Tomlison, the engineer of the water-works, responded to the toast, "Success to the Water Company," and proposed a similar compliment to the gas company, to which the chairman replied. Mr. Ledman, manager of the Norwich Gas Company, proposed "The *employés* of both companies," making a most suitable address to the men. At the conclusion of the speeches, the party repaired to Paradise, to test their cricketing skill; and each side set to work in good earnest. At the conclusion of the game, they repaired again to the Corn Exchange to tea, and at seven o'clock, the party were "homeward bound," leaving Ely with three hearty cheers. Mr. Reynold's band—a very excellent one—accompanied the adventurers, adding very materially to the pleasures of the day. The party reached Cambridge safely about eleven o'clock. It should be stated that Mr. J. I. Headley very kindly gave the loan of his steamer.

Register of New Patents.

APPLICATIONS FOR LETTERS PATENT.

2135.—Thomas Roberts, of the city of Manchester, in the co. of Lancaster, for "*Improvements in and apparatus for filtering liquids.*" Aug. 14, 1871.

2140.—James Irvine Lupton, of Richmond, in the co. of Surrey, for "*Improvements in the mode of deodorizing and utilizing sewage.*" Aug. 15, 1871.

2156.—John William Beasley, of High Street, Leyton, in the co. of Essex, plumber, for "*An improved ball-valve or tap for regulating the supply of liquids, water, steam, gas, or other fluids.*" Aug. 16, 1871.

2157.—Thomas James Smith, of the firm of Robertson, Brooman, and Co., of 106, Fleet Street, in the City of London, patent agents, for "*Improvements in apparatus for lighting and extinguishing gas.*" A communication. Aug. 16, 1871.

2180.—Edwin John Grabham, of 107, Shepherdess Walk, City Road, in the co. of Middlesex, mechanical engineer, for "*Improvements in the apparatus used for regulating the supply of gas.*" Aug. 19, 1871.

2194.—John Robert Breach, of 4, Bridgewater Square, Barbican, in the City of London, agent, for "*Improved gas-fires.*" Aug. 21, 1871.

2207.—Niels Jochumsen, of Leith, in the co. of Mid Lothian, N.B., for "*Improvements in valves applicable to pumps and other purposes.*" Aug. 22, 1871.

GRANTS OF PROVISIONAL PROTECTION.

1829.—John Joseph Franks, of Stroud, in the co. of Gloucester, civil engineer, for "*Improvements in the mode of flushing as applied to urinals and water-closets.*" July 12, 1871.

1859.—Alfred Gardiner Brown, of 63, Trinity Square, in the borough of Southwark, surgeon, for "*Improvements in means of disinfecting water-closets, urinals, as well as gutters and other conduits, and apparatus therefor.*" July 17, 1871.

1876.—Henry Vaughan, of 78, Monks Road, in the city of Lincoln, engine-fitter, for "*An improved self-acting escape-valve for drawing off the condensed fluids from steam-engines, pipes, and other vessels.*" July 18, 1871.

2062.—Alexander Angus Croll, of Coleman Street, in the City of London, for "*Improvements in meters for measuring water or other fluids.*" Aug. 4, 1871.

2076.—Andrew Barclay, of Kilmarnock, in the co. of Ayr, N.B., for "*Improvements in coking coal and generating gas for heating and other purposes, and in the apparatus employed therefor.*" Aug. 5, 1871.

2081.—John Henry Johnson, of 47, Lincoln's Inn Fields, in the co. of Middlesex, gentleman, for "*Improvements in utilizing gases from blast-furnaces, and in the apparatus or means employed therein.*" A communication. Aug. 7, 1871.

2096.—Henri Adrien Bonneville, of 18, Chaussée d'Antin, Paris, France, and 6, Piccadilly, in the co. of Middlesex, patent agent, for "*A new and improved composition for the paving of roads, streets, terraces, and other places.*" A communication. Aug. 9, 1871.

NOTICES TO PROCEED.

903.—John Llewellin the younger, of the city of Bristol, brassfounder, coppersmith, and engineer, for "*An improvement in filters for attachment to service and supply water-pipes.*" April 5, 1871.

936.—Thomas William Atlee and George Jobson Atlee, trading under the style or firm of Atlee and Son, of Birmingham, in the co. of Warwick, manufacturers and druggists factors, for "*Certain improvements in the construction of taps for drawing off fluids, and in the means of applying the same to casks.*" April 8, 1871.

1622.—MATHIEU LEON SOMZÉ, of Brussels, in the kingdom of Belgium, engineer, for "*Improvements in the construction of joints for water, gas, and other pipes.*" June 20, 1871.

1919.—ROBERT WARNER, of Jewin Crescent, in the City of London, brass-founder, and JOHN BROOKE, of the same place, foreman engineer, for "*Improvements in pumps.*" July 21, 1871.

1942.—JOHN LEWTAS, of Manchester, in the co. of Lancaster, for "*Certain improvements in the construction of lamps employed for illuminating purposes.*" July 24, 1871.

2062.—ALEXANDER ANGUS CROLL, of Coleman Street, in the City of London, for "*Improvements in meters for measuring water or other fluids.*" Aug. 4, 1871.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £50 BEFORE THE EXPIRATION OF THE THIRD YEAR.

2322.—JOSEPH SYKES BROMHEAD and JOSEPH WHITMER, "*Improvements in dry gas-regulators.*" July 23, 1868.

2328.—GEORGE SMITH, "*Improvements in machinery for obtaining rotary motion, and for raising, forcing, and measuring fluids.*" July 24, 1868.

2481.—JOHN BROADFOOT, "*Improvements in water-closets.*" Aug. 8, 1868.

2512.—JOHN WINSBORROW, "*Improvements in apparatus for measuring water and other liquids, which improvements are also applicable in obtaining motive power.*" Aug. 12, 1868.

2525.—WILLIAM PAYNE, "*Improvements in steam-cocks or valves, also applicable for hot or cold water.*" Aug. 12, 1868.

PATENTS WHICH HAVE BECOME VOID

BY REASON OF THE NON-PAYMENT OF THE ADDITIONAL STAMP DUTY OF £100 BEFORE THE EXPIRATION OF THE SEVENTH YEAR.

1759.—ALEXANDER ANGUS CROLL, "*Improvements in the manufacture or preparation of material for the purification of gas.*" July 14, 1864.

1799.—ANTOINE ESPIRAT and ETIENNE SAUSE, "*An improved filter.*" July 19, 1864.

Price Current.

CASTINGS.—*Per Ton.*

Average Weight of Cast-iron Gas-pipes, per Yard.

1 in.	2 in.	2½ in.	3 in.	4 in.	5 in.	6 in.	7 in.	8 in.	9 in.	10 in.	12 in.
16	21	28	33	51	70	89	107	126	149	177	208 lb.

Retail Prices are 5 to 10 per cent. higher.	London.	Glasgow.	Newcastle and Middlesboro'.	Wales.	Yorkshire, Derbyshire, and Staffordshire.
	£. s. d.	£. s. d.	£. s. d.	£. s. d.	£. s. d.
Pig Iron, No. 1 (g.m.b.)	4 2 6	3 3 3	2 14 0	3 10 0	3 15 0
1¼ and 2-inch Socket-pipes	7 10 0	6 10 0	6 7 6	6 15 0	7 0 0
2½ and 3-inch ditto	6 15 0	5 15 0	5 7 6	5 18 0	6 0 0
4 and 5-inch ditto	6 10 0	5 10 0	5 5 0	5 12 6	5 17 6
6 inches and upwards ditto	6 5 0	5 5 0	5 0 0	5 7 6	5 15 0
Retorts, 1st fusion, hot blast	6 0 0	5 0 0	4 15 0	5 10 0	6 0 0
Ditto, 2nd ditto, cold ditto	7 0 0	6 0 0	5 15 0	6 10 0	7 0 0
Tank-plates, ¼ thick and above	6 10 0	5 10 0	5 5 0	6 0 0	6 10 0

WROUGHT-IRON TUBING,

Subject to 60 per cent. Discount.

	⅜ in.	½ in.	¾ in.	1 in.	1¼ in.	1½ in.	2 in.
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
Patent Welded Tubes, from 2 to 14 feet—per foot	0 4½	0 5	0 7	0 10	1 1	1 3	1 8
Ditto ditto, from 12 in. to 28½ in.—each	0 8	0 9	1 1	1 6	2 0	2 3	3 0
Long Screws, from 13 in. upwards	0 11	1 2	1 6	2 0	2 3	2 9	4 0
Bends and Springs	0 8	0 11	1 3	1 9	2 3	2 3	4 3
Square Elbows, equal or reducing; Round Elbows, 5 per cent. extra	0 8	0 10	1 3	1 9	2 3	3 0	4 9
Tees, wrought or cast	0 9	1 1	1 6	2 0	2 6	3 0	4 0
Crosses, ditto, equal or reducing	1 6	1 9	2 3	3 0	3 6	4 0	4 9
Iron Cocks	3 8	5 0	7 3	10 0	13 0	16 0	20 9
Ditto, with brass plug	4 6	5 6	7 0	13 0	16 0	20 0	28 0
Diminishing Sockets, Caps, Plugs, and Nipples	0 4½	0 5	0 6	0 8	0 9	1 0	1 3
Plain Sockets	0 3	0 4	0 5	0 7	0 8	1 0	1 0
Syphons, 2-quart	—	12 0	13 6	13 0	14 0	15 0	

FREIGHTS.

Coastwise—Newcastle:—	Per Ton.	*Foreign:—*	Per Keel.
	s. d.		£ s.
Chatham and Rochester	5 9d	Barcelona	20 10
Cork	8 0	Bordeaux	10 0
Dover, Folkestone, and Ramsgate	6 0	Boulogne and Calais	7 10
Dublin	8 6	Cadiz	12 10
Exeter Quay	7 6	Cronstadt	9 10
Ipswich	5 6	Copenhagen	9 0
London (from Leith)	6 6	Genoa	18 0
London (Pool)	5 9	Hamburg	8 10
Lowestoft and Yarmouth	5 0	Havre de Grace	8 0
Portsmouth & Southampton	7 0	Leghorn	17 10
Plymouth	8 0	Lisbon	11 0
Shoreham	7 0	Rotterdam	9 0
Whitstable	5 0	Stettin	9 0
Weymouth	7 0	Trieste	18 10
		Venice	21 0

SUNDRIES.

Best Newcastle Fire-bricks, per 1000	£2 10s. to £2 15s. 0d.
Cliff's Fire-bricks (at Wortley), per 1000	2 15 0
Ingham's ditto (at Wortley), per 1000	2 15 0
Farnley Iron Co.'s Fire-bricks (at Wortley), less discount	2 17 0
Fire-clay Retorts, per foot run	5s. 6d. to 6 7 6
Tarred Rope Yarn, per cwt.	1 0 0

GAS COALS.

Newcastle—Unscreened:—	Per Ton
	8s. 6d.
Haswells, Nettlesworth Primrose, and South Pelaw	
Felling, Framwell Gate, North Pelton, Redheugh Main, Walker's Primrose, West Wear, and Whitwell Primrose	7 6
Burnhope, Craghead, Charlaw, Derwent, East Castle, Edmondsley, Eighton Moor, Hartlepool Pelaw, Holmside, Lambton's Gas, Lanchester Pelaw, Medomsley, Mickley, New Pelaw, Pelaw Main, Ravensworth, Seaham, South Moor Pelton, South Leverson, Townley Main, Tyne Main, West Pelaw, Wearmouth Hutton, and Witton	7 0
Peareth, Ravensworth Pelaw, Waldridge, West Garesfield, and West Pelton	7 3
Brancepeth, Dean's Primrose, Londonderry Gas, New Pelton, Pelton, South Peareth, Stella, Urpeth, Washington Hutton, and West Leverson	7 6
Ramsay's Newcastle Cannel	17 6
Wigan Cannel (at Liverpool)	17 0

Scotch Cannel, f.o.b.:—	Per Ton.	*Scotch Cannel*, f.o.b.:—	Per Ton.
	48s. 2d		21s. 0d
Boghead—at Bo'ness, 47s. 6d.; at Leith	27 0	Arniston (at Leith)	20 0
Muirkirk	22 6	Wemyss (at Wemyss)	21 6
Kirkness, best (at Burntisland)	22 6	Haywood Co.'s Haywood(at Granton)	17 0
Capeldrae, 1st quality (at ditto)	17 6	Pirnie, or Methill	24 6
Ditto, 2nd ditto (at ditto)	12 0	Lothian's Cannel (at Leith)	17 6
Cowdenbeath (at ditto)	12 0	Grange ditto (at Bridgeness)	23 6
Lochgelly (at ditto)	12 6	Kinniel ditto ,at Bo'ness)	17 6
Donnibristle—at Burntisland, 12s.; at Aberdour	12 6	Myles' ditto	25 0
Auchinheath Lesmahago (at Granton)	27 0	Lochore Parrot (at Burntisland)	16 0
Duke of Hamilton's Lesmahago (at Granton)	27 0	Waverley Seam (at do.)	16 0
		Lanemark (at Glasgow)	16 0
		Elphinstone Tower (at Leith)	20 0

Share List of Metropolitan Gas Companies.

Number of Shares issued.	Amount per Share.	Name of Company.	Amount paid up p. Share.	Dividend p. Cent. p. Annum.	Latest Quotations.
	£		£ s. d.	£ s. d.	£
8000	20	Anglo-Romano	20 0 0	10 0 0	20 — 22
5000	20	Bahia (Limited)	20 0 0	3 0 0	12½— 13
1000	20	Do., preference	20 0 0	10 0 0	24 — 25
750	20	Do., do., redeemable	20 0 0	10 0 0	21 — 23
40000	5	Bombay (Limited)	5 0 0	6 15 0	6¼— 7
10000	5	Do., third issue	4 0 0	6 15 0	1¼—1⅞ pm.
10000	20	British (Limited) (Norwich, Hull-Seulcoates, Hanley, Tunstall & Shelton [Potteries], Trowbridge., and Holywell.)	20 0 0	10 0 0	35 — 36
7500	20	Cagliari (Limited)	20 0 0	7 0 0	20 — 21
112000	10	*Chartered*	10 0 0	8 0 0	15⅞— 16¼
10000	10	Do., B shares, 4 per cent. max.	10 0 0	4 0 0	7¼— 7⅞
25000	10	Do., 5 per cent. preference	10 0 0	5 0 0	13⅞— 13⅞
20000	10	Do., 5 per cent. preference, second issue	8 0 0	5 0 0	2¼—2¾pm.
20000	10	Do., 10 per cent. preference	10 0 0	10 0 0	19⅞— 20¼
17490	25	*Commercial*	25 0 0	10 0 0	43 — 45
20000	20	Continental Union	20 0 0	8 0 0	26 — 28
10000	20	Do., new	7 10 0	8 0 0	3—4 pm.
5213	20	Do., preference (France: Strasbg., Cette, Nismes, Montargis, Vienne, Roanne, Beaucaire, Rueil, Aibi. Italy: Milan, Genoa, Parma, Modena, Alessandria, Messina.)	20 0 0	7 0 0	26 — 28
5000	10	*Crystal Palace District*	10 0 0	10 0 0	17 — 17½
5000	10	Do., preference	10 0 0	6 0 0	12 — 13
6044	10	Do., new shares	10 0 0	7 0 0	13 — 13½
3956	10	Do.	1 0 0	7 0 0	1¼—1⅞ pm.
23406	10	European (Limited)	10 0 0	11 0 0	16½— 16⅞
12000	10	Do., new shares (Boulogne, Amiens, Rouen, Caen, Havre, & Nantes.)	5 0 0	11 0 0	3¼—3⅜pm.
5000	10	Hong Kong (Limited)	10 0 0	10 0 0	13½— 14½
1560000	100	*Imperial*	100 0 0	10 0 0	176 —180
26000	12½	Do., new shares	12 10 0	7 0 0	16¼— 16⅞
25000	12½	Do., new shares, 1870	5 0 0	7 0 0	2¾—3¼ pm.
1300	100	Do., bonds	£100	10 0 0	190 —195
56000	50	*Imperial Continental* (Amsterdam, Berlin, Ghent, Hanover, Lille, Rotterdam., Aix-la-Chapelle, Antwerp, Bordeaux, Brussels, Cologne, Frankfort-on-Maine, Haarlem, Stolberg, Toulouse, & Vienna.)	43 15 0	9 2 6	68 — 70
400	100	Imperial Mexican (Limited)	100 0 0	nil.	
200	100	Do., new	100 0 0	nil.	
3000	40	*Independent*	40 0 0	10 0 0	68 — 70
3000	10	Do.	10 0 0	5 0 0	8 — 9
3000	20	Do.	17 0 0	7 10 0	4 —5 pm
250000	Sk.	*London*	100 0 0	10 0 0	175 —178
24000	Sk.	Do., 1st preference	100 0 0	6 0 0	120 —122
	Sk.	Do., 2nd preference	100 0 0	6 0 0	
	Sk.	Do., 3rd preference	100 0 0	6 0 0	
£18781	100	Do., 1st preference stock	100 0 0	6 0 0	121 —123
£11828	100	Do., 2nd preference stock	100 0 0	5 0 0	103 —105
15000	5	Nictheroy, Brazil (Limited)	5 0 0	5 0 0	4 — 4¼
6000	5	Malta and Mediterranean (Limited)	5 0 0	7 0 0	5⅜— 5½
20000	5	Do., preference	2 0 0	6 0 0	2⅛— 2⅜
30000	5	Mauritius (Limited)	5 0 0	10 0 0	7⅜— 8
30000	5	Oriental (Calcutta)	2 10 0	10 0 0	1¼—1⅞ pm.
10000	5	Do., new shares	5 0 0	nil.	2 — 2½
14000	10	Ottoman (Limited)	10 0 0	8 0 0	10½— 11⅛
27000	20	Pará (Limited)	20 0 0	10 0 0	35½— 36½
2600	100	*Phœnix*	40 0 0	7 10 0	53 — 55
144000	Sk.	Do., new	100 0 0	5 0 0	89 — 91
5000	20	Do.	100 0 0	5 0 0	89 — 91
	20	*Ratcliff*	20 0 0	10 0 0	33 — 35
	20	Rio de Janeiro (Limited)	20 0 0	10 0 0	33½ — 34½
6959	5	Singapore (Limited)	5 0 0	6 0 0	
2000	5	Do., preference	5 0 0	7 10 0	
1500	32½	Shanghai	32 10 0	12 0 0	
4000	50	*South Metropolitan*	50 0 0	10 0 0	88 — 90
4000	12½	Do.	12 10 0	10 0 0	21½— 22¾
20000	12½	Do., new shares	2 10 0	10 0 0	5½—5⅝ pm.
15000	10	*Surrey Consumers*	10 0 0	10 0 0	17 — 18
10000	10	Do., new	6 0 0	10 0 0	5—6 pm.
9000	4	United General (Limerick)	4 0 0	5 0 0	2⅜— 3
1500	10	*Wandsworth and Putney*	10 0 0	10 0 0	13 — 14
1500	10	Do.	10 0 0	7 10 0	7½— 8
1819	10	Do.	10 0 0	7 10 0	
1138	10	Do.	5 0 0	7 10 0	
20000	10	Western (Limited) A shares	10 0 0	10 0 0	18 — 19
10000	10	Do., B shares	9 0 0	10 0 0	7½—8½ pm.
10000	10	Do., C shares	9 0 0	10 0 0	7½—8½ pm.
20000	10	Do., D shares	1 0 0	10 0 0	3¼—4 pm.
16000	5	*West Ham*	5 0 0	8 0 0	6½— 7
10000	5	Do., new shares	1 0 0	8 0 0	1⅛— 1⅜
551	10	West London Junction (Limited)	10 0 0	6 0 0	
520	10	Do., preference	10 0 0	6 0 0	

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Contributions will be received and duly acknowledged in the JOURNAL OF GAS LIGHTING, by T. G. BARLOW, Esq., C.E., 42, Parliament Street, WESTMINSTER, who has kindly consented to act as Treasurer.

A Committee has been formed to administer the Fund, consisting of the following gentlemen, either of whom will be happy to receive contributions:—

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Mr. W. MABON, Ardwick Iron-Works, Manchester.
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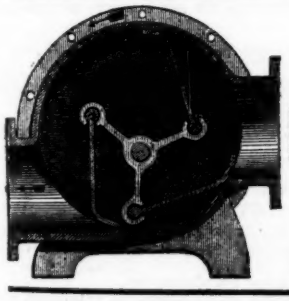

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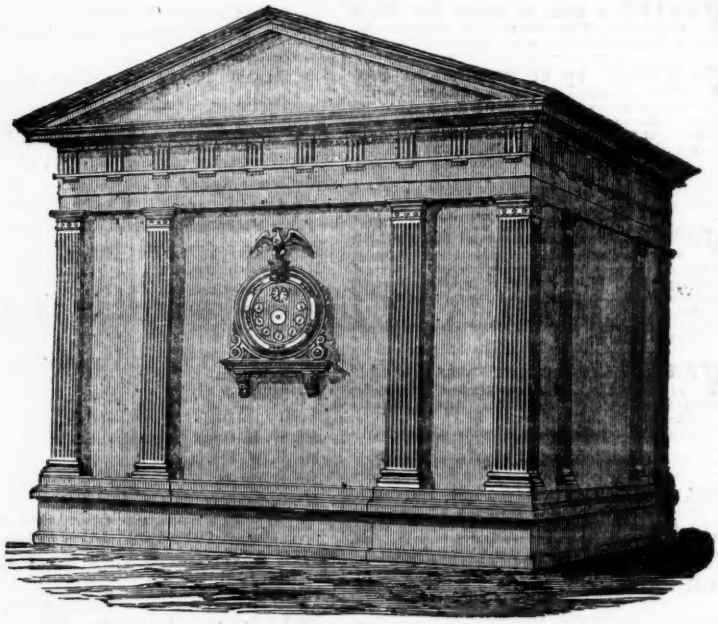

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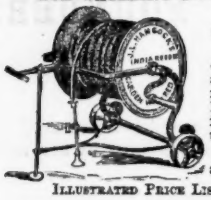

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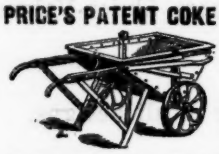

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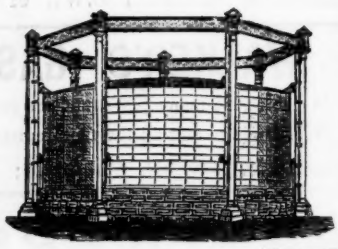

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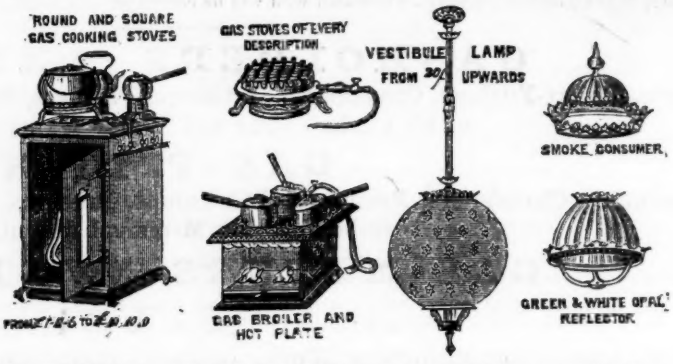
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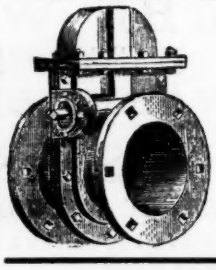

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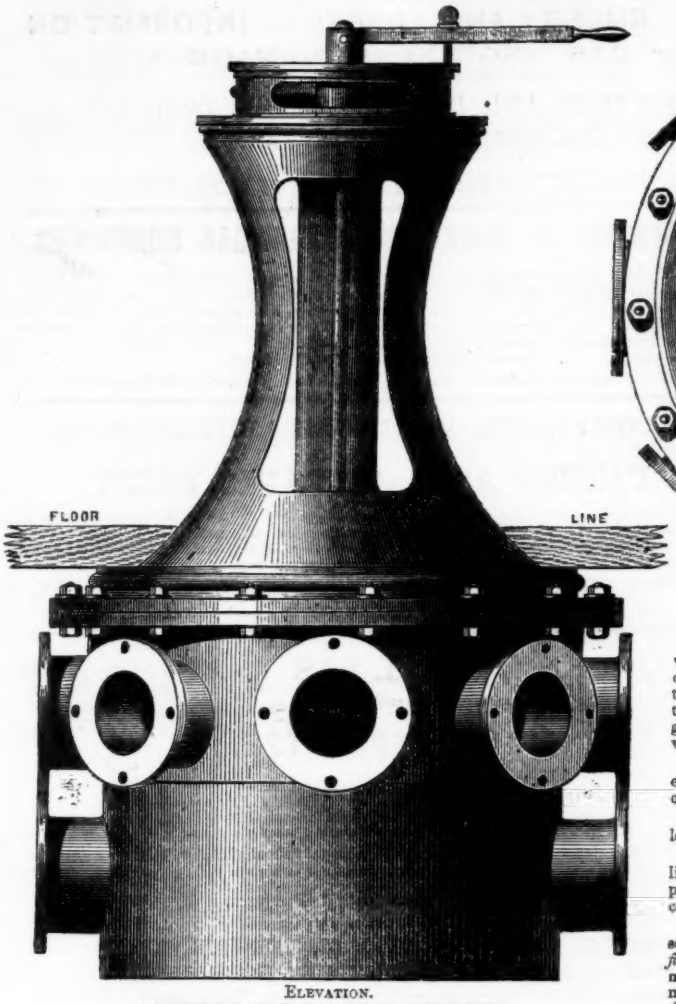

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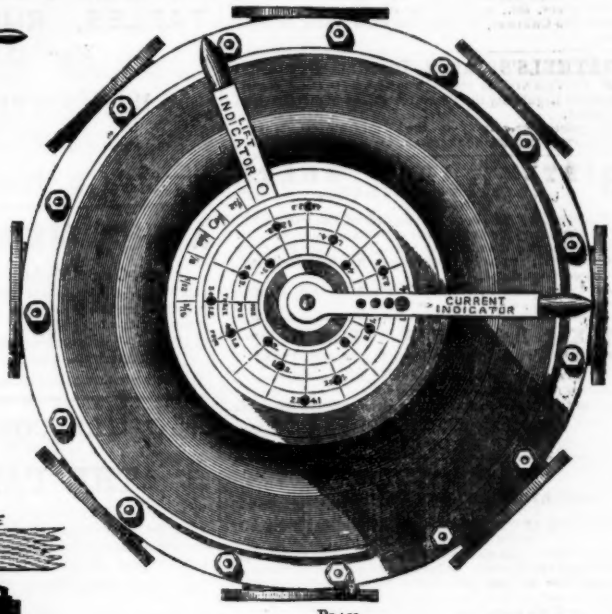

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These Valves are adapted for every purpose and position about gas-works, &c. They are constructed on the principle of the ordinary plug-cock, the internal cones or plugs being formed with divisions, and both the cones or plugs and bodies of the Valves are *recessed* in such a manner that no part of the working surface is exposed to or in contact with the gas, *thus securing a minimum of friction*, and also the preservation of the working surface *from deposit or deterioration*.

They are provided with screw gearing for relieving the weight of and easing the plug while changing the Valve, so as to preclude the possibility of any sticking or straining.

The Centre Change-Valves and Bye-pass Valves for gas purposes, occupy less space than any other. All parts are easily accessible for examination.

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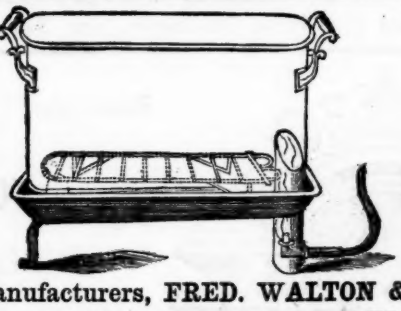
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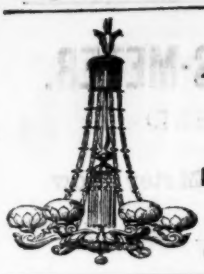

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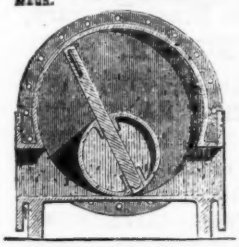

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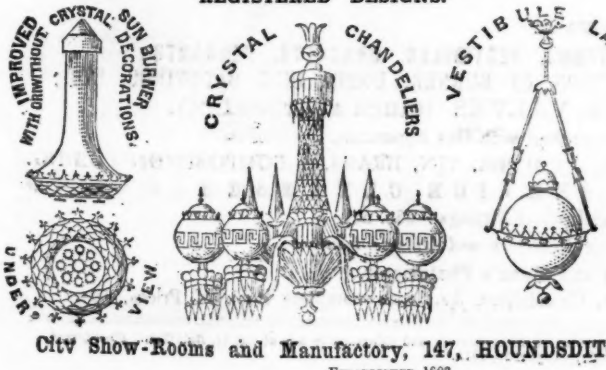

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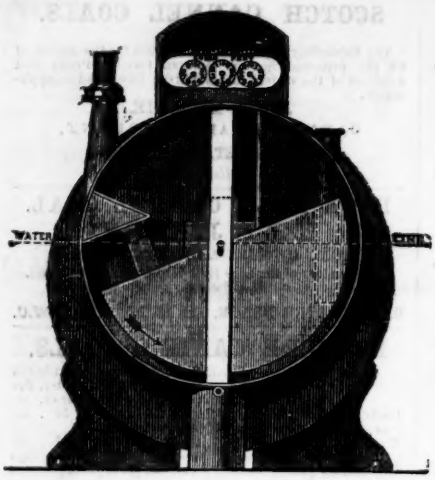

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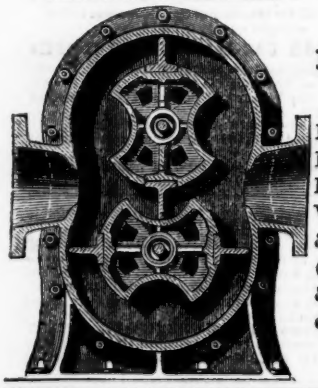

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